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THE *Dr. Schank,*
with the respects of
the author.

HESSIAN FLY:

ITS

HISTORY, CHARACTER, TRANSFORMATIONS, AND HABITS.

BY ASA FITCH, M. D.

AS PUBLISHED IN THE TRANSACTIONS OF THE NEW-YORK STATE
AGRICULTURAL SOCIETY, VOL. VI.

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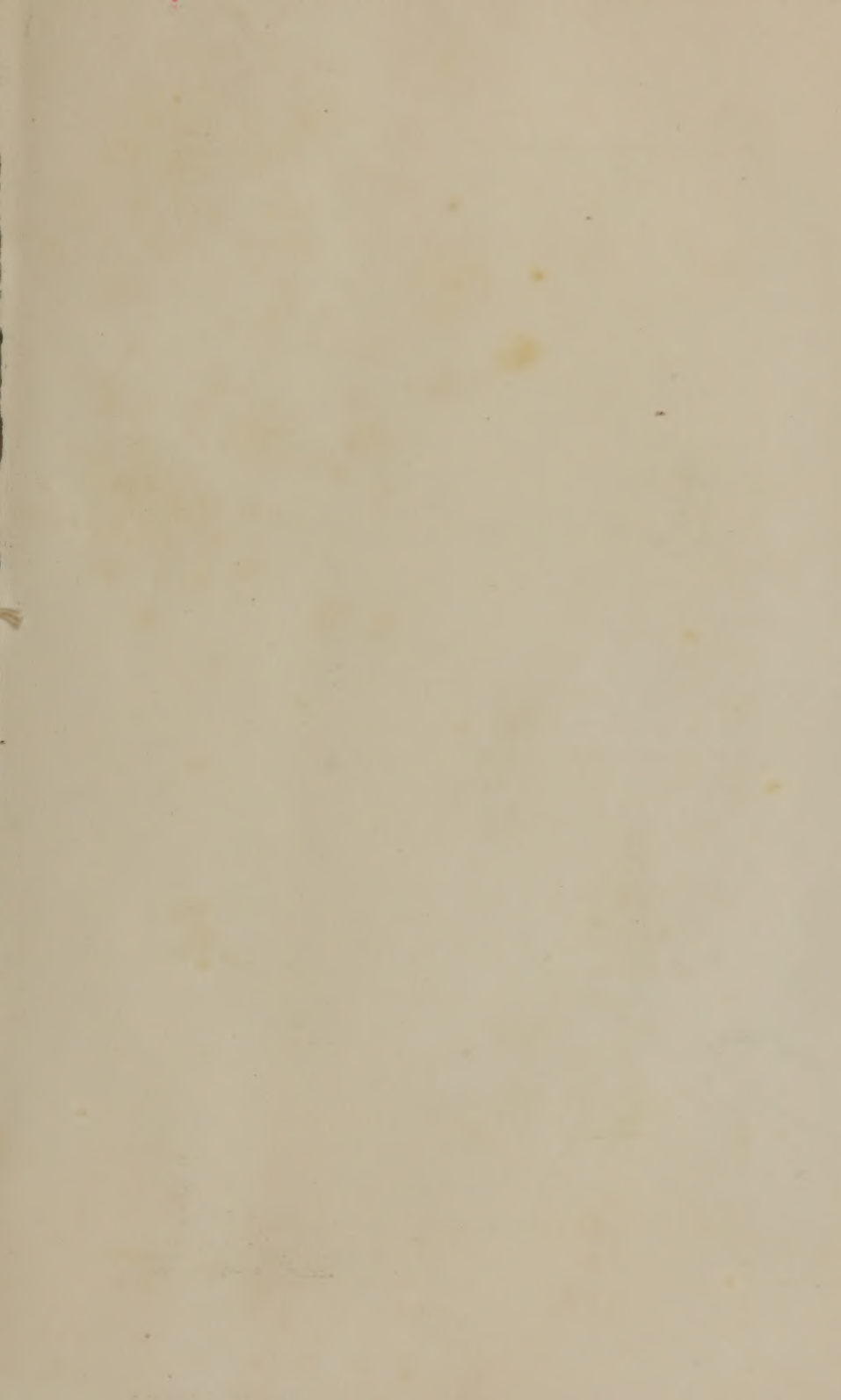
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THE HESSIAN FLY.

The insect which we are about to consider, has for a long period been, at times, a severe scourge, in every district of our country. It is more formidable to us, says Dr. B. S. Barton, than would be an army of twenty thousand Hessians, or of any other twenty thousand hirelings, supplied with all the implements of war. Hence it has forced itself prominently to the notice both of agriculturists and men of science. No other insect of the tens of thousands that teem in our land, has received a tithe of the attention, or been chronicled with a tithe of the voluminousness that has been assigned to this species. Our scientific journals, our agricultural magazines, and our common newspapers, have each accorded to it a conspicuous place in their columns. As may well be supposed, almost every point in its history, has by one and another of its observers, been closely investigated, and laid before the public. Very little that is new, can, therefore, at this day be embodied in an account of this species. The most that an observer can accomplish, is to add his testimony in confirmation of facts that have been already announced. The most that a writer can aim at, is to gather the various papers that are scattered through volumes sufficiently numerous of themselves to form a library, sift from them whatever they contain of importance, and arrange the facts thus acquired, into a connected and symmetrical memoir. Such is the object of the present essay; to carefully review the various accounts that have been hitherto published, extract from each the items of value which it contains, compare these with personal observations made under favorable circumstances during the past twelve months, and with the materials thus acquired, write out a history of this species, more

ample in its details than any that has been hitherto attempted, and containing a complete summary of all that is known of this insect down to the present day.

It is a European Insect.

For several years subsequent to the first appearance of the Hessian fly in this country, it was universally believed to have been derived from abroad. When, however, the severe devastations which it was committing upon this continent became known in Europe, public attention was so strongly excited as to lead to an extensive and thorough search for the insect there. The result of this investigation, as given by Sir Joseph Banks in his report to the British government, was, that "no such insect could be found to exist in Germany or any other part of Europe." It was in consequence, received as an established fact, and assented to on all hands, that this was an exclusively American species. Of late years, however, new light has been shed upon this subject; and we now proceed to detail the evidence which induces us to believe that the Hessian fly is indeed a European insect.

It would appear that this insect, or one identical with it in its characters and habits, did exist, and commit severe ravages in Europe, long anterior to its appearance in America. In Duhamel's *Practical Treatise of Husbandry*, (London, 1759, 4to. p. 90,) and also in his *Elements of Agriculture*, (Lond. 1764, Svo., vol. i., p. 269,) after alluding to a worm in the root of oats, he says, "I suspect it to have been an insect of this kind that *destroyed so much wheat* in the neighborhood of Geneva, and which M. de Chateauvieux describes thus: 'Our wheat in the present month of May, 1755, sustained a loss, which even that cultivated according to the new husbandry has not escaped. A number of *small white worms* have been found on it, *which*, after a time, *turn to a chestnut color*; they place themselves *betwixt the leaves*, and gnaw the stalk; they are commonly found *betwixt the first joint and the root*; the stalks on which they fix are immediately at a stand; they *grow yellow and wither*. The same accident happened in 1732: these insects appeared about the middle of May, and did so much damage that the crops were scarcely worth anything.' " This account, though per-

haps too brief and imperfect to justify a decided opinion, corresponds much more exactly with the Hessian fly, than with any other insect of which we have any knowledge. Acquainted with it, as our men of science in this country were, we are surprised that they so readily and unanimously succumbed to the sentiment that the species was indigenous to America.

In 1788, as we are informed in the *Encyclopædia Britannica*, (art. Hessian fly, §5,) the Duke of Dorset addressed a letter to the Royal Society of Agriculture in France, inquiring if the Hessian fly existed in that country. "The report of the society was accompanied with a drawing of two insects, one of which was supposed to be the caterpillar of the Hessian fly, from its attacking the wheat only when in the herb; beginning its ravages in autumn, reappearing in the spring, and undergoing the same metamorphoses." From an obscurity in the phraseology of the subsequent paragraph, and a reference therein to the memoirs of the Stockholm Academy, it would seem that the society regarded the Hessian fly as identical with the *Chlorops pumilionis* (Bjerkander) Meig.—a fly whose larva lives at the base of the stems of the wheat and rye, and which a few years before had been extremely injurious to these crops in Sweden. A doubt is therefore excited, whether the French insect might not have been this latter species. But, as the society deemed their insect to be the Hessian fly, it is somewhat singular that its history was not investigated and distinctly recorded, before the announcement was so confidently put forth, that this species could not be found in Europe.

But, more recently, clearer evidence upon this point is furnished us. Mr. Herrick, in his valuable article in *Silliman's Journal*, (vol. xli. p. 154,) informs us, that Mr. J. D. Dana, who had been much associated with him in making a thorough investigation of the habits of the Hessian fly and its parasites, being on a voyage in the Mediterranean, "on the 13th of March, 1834, and subsequently, collected several larvæ and pupæ, from wheat plants growing in a field, on the Island of Minorca. From these pupæ, were evolved on the 16th of March, 1834, two individuals of an insect, which his recollections (aided by a drawing of the Hessian fly with which he was provided), enabled him to pronounce to be the *Cecidomyia*

destructor. More of the perfect insects were evolved in the course of the month, one of which deposited eggs like those of the Hessian fly. In letters, dated Mahon, April 8 and 21, Mr. D. sent me five of the insects, and several of the pupæ. They arrived in safety, and after a careful examination, I saw no good reason to doubt the identity of this insect with the Hessian fly. The Mahonese asserted that the insect had been there from time immemorial, and often did great damage both there and in Spain." And further, "on the 28th of April, 1834, Mr. D. collected from a wheat field just without the walls of Toulon, in France, several pupæ and one larva like those before obtained. On the 4th of June, 1834, he obtained similar pupæ from a wheat field near Naples." We doubt whether there was living, at that day, two persons better qualified to determine the identity of these insects with the Hessian fly, than Messrs. Herrick and Dana. Testimony from such a source needs no comment.

Finally, the year previous to that in which Mr. Dana made the above examination, it appears that the wheat crops in some parts of Germany, were seriously injured by an insect which was generally regarded as the Hessian fly. M. Köllar, of Vienna, in his treatise on injurious insects, (London, 1840, p. 119,) relates that in the autumn of 1843, complaints were made that the wheat on the estates of his imperial highness, the Archduke Charles, at Altenburg, in Hungary, had been considerably injured by an unknown insect, of which the following account was forwarded to the archducal office. "Till the end of May, the wheat was in excellent condition, but about the commencement of June, the ears began to hang down, and the stem to bend, and in a few days patches appeared in different parts of the fields which were of rather poorer soil than the others, with the plants entangled and matted together, as though lodged by heavy rains. . . . More than two-thirds of the straw was lodged in less than a week; and the heavy rains which fell in the latter half of June, so fully completed the work of destruction, that the wheat fields looked *as if herds of cattle had gone over them*. The cause of this damage was sought for, and we soon discovered at the crown of the root of each of the wheat plants, or at the first joint, within the sheath of the leaf, whole clusters of

pupæ of an unknown insect. Those plants, the roots of which had been attacked, died off ; and the spot to which the insects had fastened themselves on the still soft straw within the sheath of the leaf, was found to be brown, withered, and tough, yet *without any apparent wound*. The straw which had become lodged, produced small ears, with few and imperfect grains, which ripened with difficulty, and the straw was twisted, and of a very inferior quality."

Nearly a hundred miles south-west of Saxe-Altenburgh, a similar account is simultaneously given by Baron Von Meninger, agricultural director of the Duke of Saxe-Coburg. According to his report, "In the fields of Weikendorf, and other neighboring localities, caterpillars were found which had devastated whole fields. These caterpillars had their first abode near the ground, in the first joint of the straw, where they were found in whole families, in a sort of nest. The largest were about the length of two lines. Their color was pale green, with a small black dot above. . . . The straw became dry at the first joint, and fell over or leaned on its neighbor. The upper part of the straw received its nourishment from the atmosphere alone, and the ears formed : but they continued in a sickly condition, and could only produce small, shrivelled grains. The life of the caterpillars (their duration as naked worms?) appeared to be from about twenty-four to thirty days. As the straw ripened, the insects changed their color into a brownish hue, shrivelled up, and finally disappeared."

M. Köllar, who seems to have known nothing of the American history of this insect beyond what he gathered from Mr. Say's brief account, obtained some of the diseased straw from Germany, in which, he says, "many of the brown pupæ were found. I opened the pupa-case, and was able to determine with great probability, partly from the form of the pupa, and partly from the unchanged caterpillar in the pupa-case, that it must be a small fly. I only ascertained this from the minute description and drawing of the insect from Mr. Thomas Say, in a North American journal, in which a stem of wheat, with the pupa within it, is exactly represented as I have seen our wheat."

Mr. Westwood, in a note appended to this account, says, it is perhaps questionable whether the species, of which the above de-

tails are given by M. Köllar, is identical with Say's *Cecidomyia destructor*. He even intimates a doubt whether the European species is a *Cecidomyia*, for, from all that had been observed, this genus in its pupa state, is naked, like the other *Tipulidæ*, and not enclosed in a case. Having himself received specimens from Dr. Hammer-schmidt of Vienna, and still in the straw near the roots, he found the insect "enclosed in a leathery case," on opening which, he discovered the *larva* shrivelled up and dead. Now this nice point, so particularly noted, and so strikingly showing the acuteness of discrimination possessed by that eminent naturalist, we think must dispel the last lingering doubt as to the identity of the American and European insects. As will fully appear in a subsequent part of this paper, the Hessian fly presents this singular anomaly, that its pupa is coarctate, or enclosed in a case like those of the *other families* of dipterous insects, but *unlike* all the pupæ of the *Cecidomyians* and other *Tipulidæ* that have been hitherto observed! The very fact, therefore, which leads Mr. Westwood to suspect the European insect is not a *Cecidomyia*, all but demonstrates that *it is the Hessian fly!*

Its Introduction into America.

The existence of the Hessian fly in Europe being premised, so many circumstances conspire to render it probable that it was introduced into this country in the mode originally supposed, that scarcely a doubt can now be entertained upon this point.

When the habits and transformations of the insect itself are considered, it will be perceived that these interpose great obstacles to its being transported across the Atlantic, at a period when two months or more were required for the voyage. Its passing through two generations in a year, makes its continuance in any one stage of its existence comparatively brief. The first of these generations occupies about seven months, from October to April inclusive. This generation is nurtured at the roots of the young plants, and there is no probability that any of these plants would be taken up, so that the insect could thus be conveyed away. The second generation is nurtured in the lower joints of the straw. The worm attains maturity in May, becomes a dormant "flax seed" in June, continues in

this state till August, when the fly comes out to deposit its eggs in September. Though most of these flax seeds remain in the stubble when the grain is harvested, numbers of them are so high in the straw, as to be gathered with it. But they are so firmly imbedded in the straw, and enveloped within the sheathing base of the leaf, that it must be rare that any of them are detached by the flail in threshing, so as to find their way among the grain, and thus with it be carried to a distance. As the flax seeds moreover, evolve the perfect insect in August, it must be equally rare that a solitary fly comes from the straw after that date. These facts clearly show that there is *but one mode*, and *but one month in the year*, in which this insect could probably have been conveyed to this country at that time, to wit, *in straw* landed upon our coast *in August*. If landed at a later date, the flies would have completed their transformations, and made their escape, or perished in their confinement; if earlier, there is no probability that the straw could have been of the growth of that year, consequently it would have contained no live insects. Our present knowledge of the habits of this insect thus affords us a singularly accurate test, for ascertaining the truth of the original theory respecting the mode in which it was introduced.

And how do the facts furnished us by the military history of those times, accord with what we have seen to be almost essential contingencies to the importation of this insect? Early in July of the year 1776, General Sir William Howe arrived on the New-York coast from Halifax, with the troops which had evacuated Boston, and debarked upon that part of Staten Island which lies within the Narrows—one of the reasons which induced him to make this part of the continent the central point of his operations being, that “Long Island was very fertile in wheat and all other corns, and was deemed almost equal alone to the maintenance of an army,” (*Bisset’s Hist. Geo. III*). We are informed in *Marshall’s Life of Washington*, (vol. ii. p. 424,) under the date of *August, 1776*, that “the reinforcements to the British army were *now* arriving daily from Europe” Lord Howe’s strength was hereby augmented to twenty-four thousand men, about half of whom (as is probable from the statement, page 416,) were newly arrived “Hessians and Waldeckers.” The most of these were from Hesse Cassel, a district

but about a hundred miles distant from Saxe-Coburg and Saxe-Altenburg, where, as we have already seen, the same insect did much damage to the wheat crops in 1833. And again, under the date of August 25, (p. 437,) it is stated, that "*on this day*, General De Heister landed with two brigades of Hessians. The next day he took post at Flatbush," on Long Island, about six miles distant from the main encampment on Staten Island.

In juxtaposition with this account, let us now place the statement of one, who, Sir John Temple, the British Consul General at New-York tells us, "had been more curious with respect to this insect, than any other person with whom he was acquainted." Says Col. Morgan, (*Encyc. Britann.*) "The Hessian fly was first introduced into America by means of some straw made use of in package, or otherwise, landed on Long Island, at an early period of the late war; and its first appearance was in the neighborhood of Sir William Howe's debarkation, and at Flatbush." So many circumstances concur to evince the truth of the account here given by Col. Morgan, to its very letter, that we think no one will hereafter hesitate to give it full credence.

We have searched in vain for the date of the embarkation of the Hessian troops, or the number of days occupied by them in crossing the ocean. It is possible they may all have left Europe anterior to the harvest. But in Germany, as in this country, as is shown by M. Köllar's statement, the infested straw becomes broken and tangled, and turns yellow, early in June. Had a company of soldiers needed straw for package, no objections would have been made to their going into a field of this kind, and with a scythe, gathering what they required, weeks before the usual time of harvest.

We have no where met with but one statement, which goes directly to prove that this insect is indigenous to this country, or existed here anterior to the arrival of the Hessian troops. The late Judge Hickock of Lansingburgh, N. Y., in a communication to the Board of Agriculture in the year 1823, and published in their *Memoirs*, (vol. ii. page 169,) says, "a respectable and observing farmer of this town, Col. James Brookins, has informed me, that on his first hearing of the alarm on Long Island, in the year 1786, (doubtless

1776 is intended,) and many years before its ravages were complained of in this part of the country, he detected the same insect, upon examining the wheat growing on his farm in this town." If this insect, observed by Col. Brookins in 1776, was the genuine *destructor*, it is a little singular that to betray its real character, it patiently awaited some fourteen years, to be reinforced by its kindred from Long Island, who reached it by regular advances made year after year—that on their arrival, and not till then, it acquired the skill and courage to go forth and lay waste the crops through all this section of country for several successive years. The strong probability is, that it was some other insect which was found by Col. Brookins.

Its Civil History and Bibliography.

We now proceed to adduce such facts as we have been able to collect, respecting the devastation of this insect in different years, or in other words, to trace out with as much precision as the data before us will enable us to do, its civil history, from the period of its first appearance, down to the present time; and in connection with this, to notice the different memoirs and other papers of value that have been published respecting it, so far as we have had an opportunity of becoming acquainted with them.

Anterior to the revolutionary war, the Hessian fly was unknown in this country. No allusion to an insect of this kind has been found in any American work, or in the journal of any foreign traveller, nor since its appearance has it been intimated that any of our citizens had ever observed it previous to that time.

All accounts concur in stating that its first appearance was upon Staten Island, and the west end of Long Island. There is some discrepancy between different writers, as to the particular year in which it was first observed. Dr. Mitchell states (*Encyc. Britann.*) that "it was first discovered in the year 1776." The ravages of the insect, however, are so much more conspicuous and liable to attract attention from the broken and tangled condition of the straw as it approaches maturity in June, than they are when a portion of the young shoots are discolored and withered in October, that there can be little doubt but it would first be observed at the

former period. Had Dr. Mitchell, therefore, received definite information upon this point, it would doubtless have been coupled with the statement, that it was noticed at or before the harvest in that year, and consequently anterior to the arrival of the Hessian troops—which fact, he, confident as he was that this was an indigenous insect, would not have failed triumphantly to have stated. It is hence believed, that Dr. M. has assumed this date, from the current report that this insect was introduced by the Hessian soldiers, knowing this to have been the year of their arrival.

From the "flax seeds" casually lodged in the imported straw, only a few flies would probably be evolved, to deposit their eggs upon the young wheat in the autumn of 1776; nor would these have multiplied to such an extent in the following spring as to attract attention at the time of harvest. But, increasing with each successive brood, by the harvest of the following year, 1778, we might anticipate its being observed, and by a year thereafter, it would become so numerous that its real character would no longer be in doubt. And in accordance with this, we are informed by Colonel Morgan, that "the fly made its first appearance in 1778;" and Mr. Clark, who in 1787 went to Long Island expressly to gather authentic information respecting this insect, says in his report, "on the best inquiry I could make, during my stay there, I satisfied myself in the following particulars, namely: first, that the Hessian fly made its first appearance there about the year 1779, so as to injure, and in some cases to destroy their crops of wheat." An anonymous writer in *Carey's Museum*, (vol. i, p. 143,) gives the same year as about the period of its discovery.

We therefore regard the year 1779 as most probably the date when its ravages actually commenced. The crops of wheat were severely injured or wholly destroyed by it in Kings and Richmond counties, during several of the following years; and each succeeding generation regularly enlarged the sphere of its devastations in every direction.

Quite early in its history, the important fact became accidentally discovered, that certain varieties of wheat are capable of withstanding its attacks. In the year 1781, a prize schooner loaded with wheat

was taken in the Delaware river, and carried into New-York, whence the cargo was sent to the mill of Isaac Underhill, near Flushing, Long Island, to be ground. Mr. Underhill's own crop of the previous year having been so entirely destroyed that he had no grain for seed, he took what he required for sowing from this cargo, and reaped therefrom upwards of twenty bushels per acre, whilst few of his neighbors for miles around had any to reap, so calamitous were the operations of the fly. To his praise be it recorded, he distributed his entire crop, in small quantities, and at a moderate price, among his neighbors, for seed; and all who made use of it were similarly successful. The "Underhill wheat" at once became noted, for effectually resisting the attacks of the fly, and for many years subsequently, as we shall have frequent occasion to notice, was eagerly sought for and successfully cultivated, where all other varieties of this grain failed. (*Vaux and Jacobs, Clark*).

In 1786, the fly reached Col. Morgan's farm, at Prospect, New-Jersey, about forty miles south-west of Staten Island. It was first observed in May, and by October was so increased, that some farmers in Middlesex, Somerset, and Monmouth counties were induced to plow up their young wheat and sow the fields to rye. Other fields, less injured, were allowed to remain until the succeeding spring, when their appearance was so disheartening, that many of them were plowed up and sowed with spring grain.

Eastward its progress would appear to have been much more rapid than towards the west and south, for this same year it had reached a hundred miles, nearly to the east end of Long Island, and was detected on Shelter Island. "It was first perceived a little before the harvest, and appeared to have come from the west end of Long Island, in a gradual progress of between twenty and thirty miles in a year. Before the harvest the species appeared to be few in number, but in the fall it was found to have greatly increased, and appeared in great numbers on the green wheat, and was observed to do most injury to that which had been most early sown." (*Havens, p. 71*).

Public attention was now becoming strongly turned towards this formidable foe. The New-York Society for promoting Useful Knowledge, issued an advertisement, requesting information respecting it. Two communications were soon received by them, and were directed to be inserted in the secular papers. These are the first published documents relating to the fly, that have occurred to our notice. They are copied into *Carey's American Museum* (Phila. vol i. p. 324-326). One of them, dated New-York, September 1, 1786, gives a brief but pretty accurate account of the situation and habits of the insect, particularly in the fall and spring. The other, dated Hunterdon, New Jersey, January 1, 1787, after hastily alluding to its habits, proposes as remedies, late sowing, on rich land; drawing elder bushes over the young plants; and passing over the wheat with a heavy roller to crush the worms.

In the *Pennsylvania Mercury* of June 8, 1787, is published a letter from Col. George Morgan, addressed to the Philadelphia Society for promoting Agriculture. He suggests the importance of their appointing some competent person to fully investigate the habits of the Hessian fly, and the remedies to protect from it, after the example of the Paris Academy of Sciences, which had commissioned Messrs. Duhamel and Tillet to enquire out the history of the Angoumois grain moth; he alludes to contradictory reports respecting the Underhill wheat, copies the paragraphs already given from M. Châteaueux, as "answering in every respect to our Hessian fly," and gives an account of the ravages of the insect in his vicinity, and its habits so far as observed.

The *Mercury* of September 14th, contains another letter from Col. Morgan, correcting some inaccuracies in his previous communication, and giving some additional interesting items. He says, "those who are doubtful whether the fly is in their neighborhood, or cannot find the eggs or nits in the wheat, may satisfy themselves by opening their windows at night, and burning a candle in the room. The fly will enter in proportion to their numbers abroad. The first night after the commencement of the wheat harvest this season, they filled my dining room in such numbers, as to be exceedingly troublesome in the eating and drinking vessels. Without exaggeration, I may say, that a glass tumbler, from which beer

had been just drank at dinner, had five hundred flies in it, within a few minutes. The windows are filled with them when they desire to make their escape. They are very distinguishable from every other fly, by their (having) horns or whiskers."

Accompanying Col. Morgan's letter is a brief report, made by Thomas Clark, who, at the request of his neighbors had gone to Long Island to gather correct information respecting the fly, and the means of escaping its depredations. He became well satisfied that the Underhill wheat, was fly proof, and could be obtained in any desired quantities, at the moderate price of \$1.25 per bushel. He also reports the interesting fact, that the fly had now become so reduced in its numbers on the west end of Long Island, that many of the inhabitants supposed there had been none the present year, though he himself saw it there quite common still. Since 1779 their crops had been destroyed more or less every year, until the present.

In 1788, a communication in *Carey's Museum*, (vol. iv. p. 47), from Buck's county, Pa., informs us that in the vicinity of Trenton, N. J., so much as the seed sown would not be harvested. Many farmers had plowed up their wheat crops in the spring, and planted them with corn. The fly also in this year commenced its ravages in the State of Pennsylvania. "Near seed-time last year, many persons on the Pennsylvania shore saw the insect so thick in the air as to appear like a cloud, coming over Delaware river."

Following this communication, is a paper signed "a landholder," who regards the eggs as laid in the grain of ripe wheat, and sowed with them; and proposes procuring seed from places not infested with the fly, as a remedy.

Messrs. Vaux and Jacobs, farmers of Providence, Pa., in July, 1788, made a tour through New Jersey and Long Island, for the purpose of gathering information respecting the fly, and the best modes of withstanding its attack. Their account is published in the *Philadelphia Packet* of August 21st, and is mainly occupied with a description of the Underhill wheat, and a full confirmation of previous reports respecting it.

On the east part of Long Island, where, as already noticed, the fly arrived in 1786, it so rapidly multiplied, that the following year many fields were nearly destroyed, and this year the third of its presence, the wheat crop "was cut off almost universally." The red-bald, which was the common winter variety there raised; and the spring wheat were equally affected. Rye in many fields was much injured, and a field of summer barley was wholly destroyed. (*Havens*, p. 73).

Wheat in large quantities, was at this period exported hence to Great Britain. Accounts of the appalling havoc that this insect was making, excited the attention of the government there, and aroused their fears, lest so dreadful a scourge should be introduced into that country, by means of the American grain. "The Privy Council sat day after day, (says *Kirby and Spence*, vol. i. p. 50), anxiously debating what measures should be adopted to ward off the danger of a calamity more to be dreaded, as they well knew, than the plague or pestilence. Expresses were sent off in all directions to the officers of the customs at the different outports respecting the examination of cargoes—despatches written to the ambassadors in France, Austria, Prussia and America, to gain that information of the want of which they were now so sensible; and so important was the business deemed, that the minutes of the council, and the documents collected from all quarters fill upwards of 200 octavo pages." In consequence of the information laid before them, a proclamation was issued by his Britanic majesty, on the 25th of June, 1788, prohibiting the entry of wheat, the growth of any of the territories of the United States, into any of the ports of Great Britain. It has been remarked as very singular, that although the *entry* of American wheat was thus interdicted, it was still allowed to be *stored* at the different seaports, thus affording the obnoxious insects, if any of them had been contained in the grain, a very convenient opportunity to escape and make their way into the country!

When the news of the closing of the British ports against American wheat reached this country, the measure was at once regarded as having resulted from misinformation respecting the habits of this insect. The supreme executive council of Pennsylvania immediately addressed a letter to the Philadelphia society for promoting Ag-

riculture, requesting the society to investigate and report to the Council the nature of the Hessian fly, and particularly whether the quality of the grain is affected by it. The society promptly replied, "that from every communication made to them on that subject, they are decidedly of opinion that it is the plant of the wheat alone, that is injured by this destructive insect, that what grain happens to be produced from such plants, is sound and good, and that this insect is not propagated by sowing wheat which grew on fields infected with it." They also refer to the letters of Col. Morgan, and of Messrs. Vaux and Jacobs, as containing the best information extant, relative to the natural history of the insect, and the most successful method of preventing its depredations. (*Carey's Museum*, vol. iv. p. 244).

Dr. Currie took an active part in showing the government and people of England, that the information which had led to the closing of the ports against the entry of American grain, was wholly erroneous; and in eight or ten months the government bought the stored wheat at prime cost, kiln-dried it, and resold it at great loss. The prohibition was taken off almost immediately thereafter. (*Memoir of Currie*, ii. 65).

In 1789, as we learn from the *Encyc. Britann.*, the Hessian fly first reached Saratoga, two hundred miles north of its original station. From the statements of several persons who were residing in Washington and Saratoga counties so long ago as this date, it appears that the crops in this district of country, (at that day second to no other in the quantity of wheat which it produced,) first began to fail about the year 1790 or 1791. The insect reached here by a regular progress from the south, coming nearer and nearer each successive year. It continued to infest the crops during a number of the following years, sometimes severely, at others but moderately. On two or three occasions, many of the fields in Saratoga county were entirely destroyed. I do not learn that in this vicinity their devastations at any time reached this extent. About the year 1803, their last depredations were committed. From that time this insect has never been observed in this vicinity, that I can ascertain, until the autumn of 1845. In Rensselaer county, however, I am credibly informed, that it was quite injurious about the year 1810.

In 1792, the recently instituted New-York Society for the promotion of Agriculture, Arts, and Manufactures, issued part first of its *Transactions*, containing (p. 71-86), "Observations on the Hessian fly, by Jonathan N. Havens." This is the most valuable memoir that had hitherto appeared upon this subject, and few of those of a later date surpass it. After sketching the ravages of the fly in different years in his own vicinity, Judge H. describes with much precision its situation and appearance in the respective stages of its existence, showing that it passes regularly through but two generations in a year, instead of three or four, as anterior writers had stated. As remedies, he recommends sowing none but the bearded wheats, and burning or plowing up the stubble soon after harvest. This last important measure had never before been proposed; Judge H. had been led directly to it, by a close investigation of the habits of this insect.

The American Philosophical Society this year appointed from among its most competent members, a committee (Thomas Jefferson, B. Smith Barton, James Hutchinson, and Casper Wistar), "for the purpose of collecting and communicating to the society materials for forming the natural history of the Hessian fly." This committee immediately issued a circular, requesting all persons acquainted with any facts relating to this insect, its depredations, and preventives, to communicate the same by letter to their chairman. The numerous points upon which information was desired, were particularly detailed in an extended series of questions, which clearly indicate the importance which they attached to this subject, and the thorough investigation which they proposed making. (*Carey's Museum*, vol. xi. p. 285). It cannot but be regretted that this business, committed to such capable hands, was not pursued and brought to a close with the same zeal with which it was evidently commenced. We have met with no report ever rendered by them.

At this time, as we infer from a clause in the circular just alluded to, and also from some passages in Dr. Mitchell's address before the New-York Society of Agriculture (*Transactions*, vol. i. p. 32,) the insect was becoming so rare in all the more densely settled parts of the Middle States, which had been first overspread by it, that it was the common opinion that it would soon vanish from the country en-

tirely. Notices of it in the magazines and newspapers become more rare, and it was evidently ceasing to be regarded with that intense solicitude which it had hitherto excited. It was, however, with unabated vigor, continuing its progress southward. A letter from Prospect Hill, Delaware, dated June 12th, 1792, (*Carey's Museum*, vol. xi. p. 301,) states that the fly arrived there "in prodigious clouds," about the middle of the preceding September. It describes the place where eggs were deposited on the young wheat, the growth of the worm, and the perishing of all the plants, except those growing upon a rich soil, and adds further testimony in favor of the Underhill wheat.

In 1797, Dr. Isaac Chapman, of Bucks county, Pa., prepared one of the best accounts of this species that has ever appeared, containing the details of his own careful observations upon the insect and the time of its appearance in its different stages. These observations led him to recommend as the most certain safeguards against the fall attack, late sowing, and against the spring attack, a quick vigorous growth, to be obtained by procuring southern seed and sowing it on a rich, elevated and dry soil. His paper is published in the fifth volume of the *Memoirs of the Philadelphia Society for promoting Agriculture*, a volume which we regret having been unable to find in either of the largest libraries of this State. We are therefore obliged to depend for its contents upon second hand accounts. Dr. C. states that the fly was this year found upon the west side of the Alleghany mountains.

The eighth volume of the *Encyclopædia Britannica*, published this year, gives (pages 489-495) an extended article under the head *Hessian Fly*, consisting chiefly of a summary of the several documents laid before the privy council during their investigations.

In Dr. B. S. Barton's *Fragments of the Natural History of Pennsylvania*, issued in 1799, the author announces (p. 23) his intention of publishing "a memoir upon that destructive insect called the Hessian fly." It is probable that whatever communications were addressed to the committee of the Philosophical Society, had been consigned to his hands. We are not aware that the promised memoir ever appeared.

“About the year 1801, the Hessian flies first made their appearance in the neighborhood of the city of Richmond. We saw but little mischief that year. But in 1802 they were much more destructive—1803, they swept whole fields—about the same in 1804” (*H. McClelland, Amer. Farmer*, vol. ii. p. 234).

In the year 1803, we arrive at the first notice of this species, of a scientific nature. Dr. Mitchell, in a short article in the *Medical Repository* (vol. vii. p. 97, 98), entitled “Further ravages of the wheat insect, or *Tipula tritici* of America, and of another species of *Tipula* in Europe,” states that it is now understood that our insect is a *Tipula*. He alludes to the extent of this genus, (ninety-four species being enumerated by Weber,) and though he has often examined our insect, and bred it so as to observe its transformations, he declines giving a decided opinion whether or not our species is different from all those that had been described. He refers to the species “treated as a nondescript” by the Rev. Mr. Kirby, in the *Linnæan Transactions*, copies its name and technical characters, and closes with the remark, that whether Mr. Kirby’s insect is a new one or not, it is not the same animal which has been so injurious in this country. Had the doctor but added a few words descriptive of our species, he would undoubtedly be entitled to “the barren honors of a synonym.” Respecting the depredations of the insect at this time, we learn from him, that “during the cold and dry spring of 1803 these creatures again infested the wheat more than they had done for many years. Many crops were cut off early in June, and the ground plowed up for other purposes.

During a long interval we meet with no further notices of this species. Its depredations would appear to have been so slight, and public attention was so much engrossed, with other affairs, that nothing, as we have discovered, is recorded of it.

At length, in 1817, it is stated to have renewed its ravages in various sections of the country. In the neighborhood of New-York and of Philadelphia, it is evident that it was unusually abundant, and in parts of Maryland and Virginia, it was perhaps more destructive than it had ever been before.

It was on the 24th of June in this year, that Mr. Say read before the Philadelphia Academy of Natural Sciences a paper entitled "Some account of the insect known by the name of Hessian fly, and of a parasitic insect that feeds on it." This contains an accurate technical description of the insect, on which he bestows the name of *Cecidomyia destructor*, and also of its most common parasite, referred by him to the genus *Ceraphron*, and also named *destructor*. This paper was published in the *Journal of the Academy* (vol. i. p. 45-48), issued in the course of the ensuing month, and was followed in August by a copperplate illustration of these insects, drawn and engraved by Mr. C. A. Le Sueur. "A local habitation and a name" were thus conferred upon this world-renowned species, by which it has ever since been definitely specified and arranged in works of science.

In the *American Monthly Magazine and Critical Review* for August, 1817, New-York, (vol. i. p. 275-279,) appeared a paper bearing the title, "An account of the wheat insect of America, or the *Tipula vaginalis tritici*, commonly called the Hessian fly." This paper gives the substance of Judge Havens's memoir, and professes to copy a technical name and description which had been published by Dr. Mitchell in the *New-York Gazette* of July 3d. But whoever refers to the *New-York Gazette*, will find no attempt at a technical description, and no name except that of *Tipula Tritici*, which is in one instance, casually as it were, made use of. The word *vaginalis* is therefore an interpolation of the writer in the *Magazine*; and as he, at least on some subsequent occasions, refrained from bringing this name farther into notice, when a fair opportunity was presented him for doing so (as editor of *Hooper's Medical dictionary*, &c.) we doubt not, when the excitement of the day was past, he deeply regretted that he had ever drawn up an article so derogatory to himself as that which appears in the *Magazine*. We should therefore suppress all allusion to this subject, with the hope that it might pass wholly into oblivion, but that the article from the *Magazine* has of late years been copied into some of our agricultural journals, and has been referred to in terms of commendation by some names of respectability. With the currency thus unfortunately given to it, it will be read by hundreds who can never see the *New-York Gazette*, and will thus deem, that one

of our most distinguished savans had degraded himself by a paltry attempt to forestall Mr. Say in giving to this species a technical name.

Gen. John H. Cocke this year communicated his observations to the Albemarle Agricultural Society of Virginia. Having well ascertained that the fly deposits its eggs upon the blades of the wheat, at from a half to three inches from the central stalk, and that these remain there four or five days before they hatch, he recommends feeding off the crop, by pasturing sheep upon it; thus destroying the eggs, and depriving the fly of its wonted place for depositing them. "A King William Farmer" dissents from this advice, and thinks covering the seed to the depth of three inches the best safeguard against the fly. "A Frederick County Farmer" and Dr. Merriwether oppose this, and a controversy ensues, reaching through several communications in the *Richmond Enquirer* and *National Intelligencer*, and afterwards continued in the *American Farmer*, till in 1820 it was brought to a close by a valuable article from that distinguished agriculturist, the late James M. Garnett, (*American Farmer*, vol. ii. p. 174,) accompanied by an illustration, which would seem to clearly demonstrate the correctness of the statements first put forth by the King William Farmer. This subject will be fully considered in a subsequent part of this essay.

In 1820, Edward Tilghman, of Maryland, described (*American Farmer*, ii. 235) the place and mode of deposition of the eggs, he having in numerous instances watched the fly in the very act of ovipositing. At a later day Mr. T. has favored the public with a more full and exact description of this process, (*Cultivator*, viii. p. 82). James Worth of Pennsylvania, also in 1820 minutely described from his personal observations, the situation of the egg, its hatching, and the journey of the worm down the leaf to its usual nidus, (*American Farmer*, ii., 180).

In the second volume of the *Memoirs of the New York Board of Agriculture*, issued in 1823, is a communication (p. 169-171) on the Hessian fly, from Judge Hickock, who deems a fertile soil the best safeguard. In the third volume of the same work, published in 1826, (p. 326-338,) is a paper by the indefatigable secretary of

the board, the late Judge Buel, giving a condensed summary of all the information respecting this insect, contained in the accounts of Judge Havens, Dr. Chapman, and the different writers in the *American Farmer*.

In 1840, Miss Margaretta H. Morris, of Germantown, Pa., in a communication to the American Philosophical Society, revives the theory of "a landholder," already noticed, that the egg of the fly is deposited in the grain, and that obtaining seed from uninfected districts will therefore be the best safeguard. The report of the committee upon this paper, is inserted in the society's *Proceedings* of November, 1840, and the paper itself is published in the society's *Transactions* (vol. viii. p. 49-51). Communications bearing upon the same subject were also made to the Academy of Natural Sciences, in 1841, by Dr. B. H. Coates, (*Proceedings Acad.*, vol. i. p. 45, 54 and 57).

In 1841, Mr. E. C. Herrick, librarian of Yale College, gave "a brief, preliminary account of the Hessian fly, and its parasites," in *Silliman's Journal of Science* (vol. xli., p. 153-158). This paper announces the interesting fact of Mr. Dana's having met with apparently the same insect on the shores of the Mediterranean, details the writer's own accurate observations of the changes from the egg to the flax seed state, and enumerates four different parasitic insects that prey upon it during these periods of its existence, by which "probably more than nine-tenths of every generation of the Hessian fly is destroyed." Another valuable paper from Mr. Herrick appears in the *Report of the Commissioner of Patents* for the year 1844, (p. 161-167), giving a most exact and particular history of the transformations of this insect, and a summary view of the various remedial measures that have been proposed. Both of these papers evince the close and patient investigation which the writer had made, and the utmost carefulness in announcing nothing beyond what he had clearly ascertained.

Dr. T. W. Harris's invaluable "Treatise on the insects of Massachusetts injurious to vegetation" was also completed in 1841. An excellent summary of all the leading facts pertaining to the histo-

ry of this species, is given in this work, and its generic place, upon which point Mr. Herrick, Latreille and others had intimated doubts, is correctly settled.

The numerous agricultural periodicals of our country, abound with notices of this insect, more or less extended and valuable. To specify these notices in detail, at least as respects some of these periodicals would require a reference to almost every number issued. Wherever important facts are derived from these sources, in the course of this essay, they are accompanied by a particular acknowledgment in each instance; an additional reference in this place, is therefore deemed unnecessary.

We close this section of our subject, with a condensed view of the depredations of this insect in different parts of our country during a few of the past years; the materials for which, are furnished us, in those valuable documents, the yearly reports of the Commissioner of Patents.

In the year 1842, the ravages of the Hessian fly would appear to have been quite limited. Pennsylvania suffered the most severely. The wheat crop in this State is estimated to have been twenty per cent less than it was the preceding year, and of four different causes that produced this diminution, the fly is placed first. Some parts of Maryland, and also of Ohio, were visited by it. In the latter State it appeared to be increasing so much, that serious apprehensions were beginning to be felt respecting its future ravages.

In 1843, it was so abundant in western Pennsylvania in June, that it was thought it would diminish the crop twenty-five per cent. Through Maryland, and the great wheat-growing valley of Virginia, it was noticed at the same time as committing great havoc in many fields, and threatening a very decided failure in the crop; at harvest, however, the yield was found to be much better than was anticipated. In Ohio it was less injurious than in the preceding year. Upon some parts of Long Island it was observed, but in limited numbers.

In 1844, it seems to have been much more destructive than in either of the preceding years, and to have made its appearance pro-

minently in some districts where it had been unobserved before. Thus, through all the northern parts of Indiana and Illinois, and the contiguous parts of Michigan and Wisconsin, it did much injury, and in many places occasioned almost a total failure of the crops. Near Goshen, Ia., a person writes, the fly is taking the wheat here at a dreadful rate, destroying some pieces entirely; some fields have been plowed up, and corn planted therein. The *Prairie Farmer* states that the wheat crop has suffered severely in various sections by the fly. In Will county, Ill., says the *Chicago Journal*, several entire fields of both winter and spring wheat have been destroyed by the Hessian fly. In Michigan also, it is reported to have made sad havoc, particularly in light sandy soils. From different places in this State, we are told as follows: "In some cases the injury was so severe, that the farmers had to plow up their fields and sow them over again." "There is not more than one-fourth of the surplus of 1843, owing to the wet season and the ravages of the fly." "The wheat crop is almost an entire failure. The insects took it last fall, and the rust in the spring, and then again the insects a second time." It is also stated that the same enemy had made its appearance in great force at the close of the season, in the early fall sown wheat. From different parts of Ohio, the crop was reported in May and June to be suffering considerably from the ravages of the fly. In the vicinity of Masillon, it had never been so destructive before, whole fields being entirely destroyed. In the neighborhood of Rochester, N. Y., also, the fields suffered some, particularly those having a sandy soil, and that were early sown. On the west end of Long Island, its ravages were also bad, many farmers not having more than half a crop. Both in the eastern and western sections of Pennsylvania, the fly lessened the produce of this year. In Bucks county it was particularly destructive. One person states, in the month of June, that where he had expected to gather 1,200 bushels or more, he could not now hope for 300. Though it is noticed on both shores of the State of Maryland, the injury done by it here appears to have been but slight.

In 1845, through those districts of Michigan, Indiana and Illinois, where it committed such havoc the last year, it is said by different persons to have wholly disappeared. The *Prairie Farmer*, however, states that it was still present, doing more or less injury all over the

State of Illinois. Ohio sustained but little injury. It is not noticed north of Maryland, in the central parts of which State it is reported that on nearly all the light lands the Hessian fly made serious ravages, and in many instances rendered the crops totally worthless. In Georgia, moreover, its ravages in the counties around Milledgeville are said to have been dreadful ; whole fields were totally destroyed, and others yielded not more than a fourth of an ordinary crop.

We regret that we have not at hand the requisite information, for tracing with equal precision the ravages of this insect during the past year, 1846. From such notices as we have casually observed in the public papers, we presume that through the country generally, it has been unusually numerous. In this vicinity, some fields have produced less than a fourth of what they would have done, but for the invasion of the fly last autumn, after an absence of over forty years, and its great increase in the spring. On sandy soils in Saratoga and the north-west parts of Rensselaer counties, several fields were observed early in July with the wheat stalks so "few and far between," that no harvesting of them would be attempted ; whilst many others had been, at an earlier period of the season, plowed up and occupied with spring crops. In the western section of the State, it has also been quite destructive. The loss from the fly alone, says the *Genesee Farmer*, (vol. vii., p. 251,) will doubtless be at least 500,000 bushels. In those districts of Illinois, Wisconsin, and Iowa, which are contiguous to the Mississippi river, it appears to have been common, and also in eastern Pennsylvania. From a minute in the proceedings of the trustees of the Maryland Agricultural Society, we learn that "so great ravages have not been committed by the Hessian fly, since 1817. On some of the best land wheat has been plowed up, and other portions are so much injured, that they will not be worth harvesting. At least one-half of the crop of Talbot county has been destroyed." And in the 'upper counties of Georgia, it is said, "the fly has committed such ravages upon the wheat, as scarcely to leave enough seed for another year."

Its Name and Synonyms.

It is a somewhat trite but very true adage, that "names are things." Every one who has had occasion to search through files

of our agricultural journals for information respecting any particular insect or other malady to which our crops or herds are subject, well knows what doubt and perplexity is often occasioned from having two or more names used by different writers for the same thing, and also from having two or more distinct things designated by the same name. To illustrate this, let us refer to the *Patent Office Report* for 1844, p. 26, where, in thirteen consecutive lines, we read as follows: "Near Onondaga county the wheat is said to be injured by the *grain worm*. . . . In Schoharie we find complaints of the *weevil*. . . . In Schenectady county the ravages of the *fly* were great. . . . In parts of Columbia county it suffered from the *maggot*. . . . In Dutchess a yellow *worm in the head* destroyed it." Of a truth, "what a host of enemies!" By way of climax, we only require some wiseacre who has never seen the insect, or lived within a hundred miles of it, to say, "Good people, you are all wrong; *wheat worms* is the correct name for your insect"—and we are furnished with a tolerably complete list of the popular synonyms of the *Cecidomyia tritici*! But who, not intimately conversant with its American history, would suspect this single species of being designated by such a profusion of terms. Who, on reading the page referred to, of the *Patent Office Report*, (and it is a correct transcript of the very words which are in popular use,) but would receive its statements as conclusive evidence that we had in eastern New-York at least four or five kinds of destructive insects preying upon our wheat crops. Such mistakes are the inevitable result of a diversity of names. So important, therefore, do we deem this topic, that we are induced to assign to it a distinct head.

It is very fortunate that no confusion of the kind just alluded to, has ever existed with reference to the species under consideration. Its popular name, *Hessian fly*, was first bestowed upon it by Colonel Morgan, soon after its appearance on Long Island. Some two or three of the earliest writers allude to it by the names of *Hessian bug*, and *Hessian insect*, but these designations were speedily dropped, and *Hessian fly* became universally the only name by which it was definitely distinguished, not only in this country, but in all parts of the world where the English language was spoken. Even when it was by every one deemed to be a native insect, and the epithet

Hessian was therefore remarked by different writers as most inappropriate, still it was in such universal use, that no one ventured to propose that it should be changed. And this continues to be the only name by which it is spoken of at the present day, with one or two exceptions. In the *Ohio Cultivator* it is designated as the "wheat fly," and in late volumes of the *Genesee Farmer* the names *Hessian fly* and *wheat fly* are indiscriminately applied to it. The name "wheat fly," however, had been anteriorly and extensively applied to the *C. tritici*, upon both sides of the Atlantic, and was indeed the only common name of that insect in use among writers in agricultural journals and popular treatises, until recently, the perhaps more judicious name of "wheat-midge," has been bestowed upon it, by some of the best foreign authorities.*

* We may here state some additional reasons which induced us in our former essay, to adopt the name "wheat-fly" in preference to that of "wheat-midge," the name by which the *C. tritici* has been designated by Mr. Curtiss, Westwood, and some other recent writers.

1. The insect itself, is, next after the wholly inappropriate name of "weevil," most commonly called "the fly," we believe, in all those districts where it is most abundant and has been longest known. It is never called "the midge." Why, then, should we speak one common name, and write another; or have in print as the common name, what we well know *is not* the common name.

2. No other insect in the world has a popular name better established than the *Hessian fly*. Both it and the *C. tritici* will undoubtedly continue to be common insects in this country, and very frequently spoken of. If one is called the *Hessian fly* and the other the *wheat-midge*, every person not well acquainted with this subject, will imbibe the idea that they are very different insects, their names being so dissimilar; whereas, they are most closely allied to each other.

3. It has often been remarked as a great desideratum, that the technical and common names of species in natural history, should correspond with each other; or, in other words, that the common names should in all cases where practicable, be translations of the technical names. *Cecidomyia tritici*, literally rendered in English, is *gall-fly of the wheat*; but inasmuch as this species does not produce galls, there is an obvious impropriety in retaining that word. *Wheat-fly* thus becomes the most direct translation of the technical name, that the habits of the insect admit of. No one will maintain that *wheat-midge* is a translation.

Dr. Webster is in error in saying the word "midge" is "not in use" at the present day: In the neighboring Green mountain districts, one or more most annoying species of *Simulium* that there abound, are daily designated in common conversation as the *midges*, or, as the name is often corrupted, the *midgets*. From Dr. Harris' treatise it appears that the same name is in popular use for the same insects in Maine. The term is limited in this country, we believe, exclusively to those minute insects, smaller than the musketoe, which suck the blood of other animals.

The scientific name, *Cecidomyia destructor*, bestowed upon this species by Mr. Say, is the only one belonging to it, neither the name *Tipula tritici*, nor *Tipula vaginalis tritici* having any legitimate claims to be retained as synonyms. Mr. Say's name might at first view be thought liable to criticism, as being in no wise distinctive, many other species of Cecidomyians being also *destroyers*. Yet this species is so preëminent in that particular, as to throw the injuries inflicted by each of the others quite in the back ground. We hence think it will be conceded that the name is signally appropriate. Placed beside it, all its kindred are mere depredators—this alone is **THE** *destroyer*.

Its Characters, Transformations, and Habits.

As a general rule, the Hessian fly passes regularly through two generations annually. The first of these occupies the autumn, winter, and fore part of the spring, and is reared at the roots of the young grain, slightly below the surface of the ground. The second occupies the remainder of the spring and the summer, and is chiefly nurtured at the first and second joints of the straw. The time when its several transformations occur, is not perfectly uniform, being varied by the climate, the state of the weather, and perhaps other contingencies; and it is not improbable that individual specimens, placed in circumstances unfavorable to their developement, have their growth retarded so much as to require even a whole year to complete their metamorphoses.

First Generation.

THE EGG. *When and where deposited.*—The eggs of the first generation are deposited chiefly in the fore part of September. Dr.

But, inasmuch as we have another common word (gnat), applied to species having in this respect the same habit, in the paucity of terms which our language furnishes by which to designate insects, it is desirable that no two of these terms should be employed as synonymous. And as the night midge (Anglo-Saxon *mygge* or *micge*, a warmer,) is appropriate for all those minute flies which assemble together in aerial dances, it would be well to adopt it as the generic or family term for all the small Tipulidæ, and apply the term gnat only to the Culicidæ or musketoe family. This appears to be the mode in which the English entomologists at present employ these words. And in this country it will probably be more easy to bring the new name, wheat-midge, into common use as the distinctive appellation of the *C. tritici*, than to have any one of the names now bestowed upon it supersede all the others.

Chapman says the deposit is made from the latter end of August till the 20th of September, and most other accounts coincide with this, though some extend the time into October. On the 8th of October the fly was seen ovipositing in eastern Pennsylvania, in 1819, and it had wholly disappeared on the 11th. (*Amer. Farmer*, ii. 180). The deposit is doubtless made later, at the south, than in this vicinity. Mr. Tilghman's description of this process (*Cultivator*, viii. 82,) will convey so much more distinct a view to the general reader, than any other that has ever been published that we here insert it. He says, "By the second week of October, the first sown wheat being well up, and having generally put forth its second and third blades, I resorted to my field to endeavor to satisfy myself by ocular demonstration, if I could do so, whether the fly did deposit the egg on the blades of the growing plant. Selecting what I deemed to be a favorable spot to make my observation, I placed myself in position, by reclining in a furrow between two wheat lands. It was a fine, warm, calm forenoon; and I had been on the watch but a minute or two, before I discovered a number of small black flies, alighting and setting on the wheat plants around me; and so strong seemed to be their predilection for the wheat, that I did not observe a single fly to settle on any grass, or any thing within my view, but the wheat. I could distinctly see their bodies in motion when settled on the leaves or blades of the wheat, and presently one alighted and settled on the ridged surface of a blade completely within my reach and distinct observation. She immediately commenced disburthening her apparently well stored abdomen, by depositing her eggs in the longitudinal cavity between the little ridges of the blade. I could distinctly see the eggs ejected from a kind of tube or sting, or by the elongation of the body; the action of the insect in making the deposit, being similar to that of the wasp in stinging. After she had deposited, as I supposed, some eight or ten eggs, I easily caught her, upon the blade, between my finger and thumb. After that, I continued my observations on the flies, caught several similarly occupied, and could see the eggs uniformly placed in the longitudinal cavities of the blades of the wheat; their appearance being that of minute reddish specks."

Its appearance and characters.—The account of the eggs, and also of the worms of the Hessian fly, as given by Mr. Herrick, is drawn up with such scrupulous care, and is so full and definite in every particular, that we are constrained to enhance the value of this essay by presenting it entire. He says; “The eggs are laid in the long creases or furrows of the upper surface of the leaves of the young wheat plant. While depositing her eggs, the insect stands with her head towards the point or extremity of the leaf, and at various distances between the point and where the leaf joins and surrounds the stalk. The number found on a single leaf, varies from a single egg up to thirty, or even more. The egg is about a fiftieth of an inch long, cylindrical, rounded at the ends, glossy and translucent, of a pale red color, becoming, in a few hours, irregularly spotted with deeper red. Between its exclusion and its hatching, these red spots are continually changing in number, size, and position; and sometimes nearly all disappear. A little while before hatching, two lateral rows of opaque white spots, about ten in number, can be seen in each egg. In four days, more or less, according to the weather, the egg is hatched.”

THE LARVA. Growth of the worm, or active larva.—Mr. Herrick’s excellent description is continued as follows, “The little wrinkled maggot, or larva, creeps out of the delicate membranous egg skin, crawls down the leaf, enters the sheath, and proceeds along the stalk, (see fig. *m*,) usually as far as the next joint below,” (fig. B. §§,) or, in other words, *to the base of the sheath*, which in the young autumnal wheat, is at the crown of the root, (fig. A. §.) “Here it fastens, lengthwise, (fig. *n* and *o*,) and head downwards, to the tender stalk, and lives upon the sap. It does not gnaw the stalk, nor does it enter the central cavity thereof; but, as the larva increases in size, it gradually becomes embedded in the substance of the stalk. After taking its station, the larva moves no more, gradually loses its reddish color, and wrinkled appearance, becomes plump and torpid, is at first semitranslucent, and then more and more clouded with internal white spots; and when near maturity, the middle of the intestinal parts is of a greenish color. In five or six weeks (varying with the season,) the larva begins to turn brown, and soon becomes of a bright chestnut color, bearing some resemblance to a flax-seed, &c.”

Its characters.—When freshly taken from the root of the wheat the mature worm (fig. g,) measures about fifteen hundredths of an inch (0.15) in length, by about 0.06 in breadth. It shows no signs of life when placed upon paper and turned over with a needle point. It is soft, glabrous, shining, white, oval and apparently composed of but nine segments, although twelve can often be distinctly perceived before its growth is completed. These are quite slightly marked by faint transverse lines of a greenish brown hue. Its under side is flattened, and has an oblong grass green cloud or spot in the middle, placed longitudinally. No regular contractions or crenatures occur along the margin to mark the segments, though after the worm has laid exposed to the air an hour, the color of the transverse lines above spoken of becomes bleached out as it were, and then, perhaps from the worm's having become somewhat dried, faintly impressed transverse lines are perceptible at the junction of each of the nine segments: faint longitudinal striæ are also discernable, as though produced by the pressure of the parallel veins or ribs of the sheath and culm, between which the worm had laid.

Its mode of feeding.—We have hitherto sought in vain to ascertain, by ocular and microscopic examinations, how it is that the worm imbibes its nourishment from the stalk. To expose it to view, we are obliged to place it in circumstances so unnatural to it, that it apparently refrains from feeding. That it “gnaws” the stalk, as some writers in our agricultural papers, and some compilers of popular treatises inform their readers, is an error so gross as scarcely to deserve notice. Some have supposed that it absorbs its nourishment through the pores of its skin; but we incline to the belief that Dr. Lee's opinion is nearest the truth of any that has been hitherto advanced—that it takes in its nourishment by suction, in a manner more analogous to the leech than any other familiar object. (*Gen. Farmer*, vii. 225).

Its effects upon the crop.—The autumnal attack of the fly is in a double sense a *radical* one. Each particular shoot at whose root one or more of these larvæ nestles, is commonly destroyed by the time the worm has attained its growth. The presence of these worms is therefore readily detected by an examination of the young wheat in October or November. Individual shoots will be found

here and there in the field, withered and changed to a light yellow color, (fig. A. †), strongly contrasting with the rich green of the vigorous uninjured plants, (fig. A. *). The frost or some other casualty may cause the ends of some of the other leaves to be of a pale yellow color, but here the whole plant is of that hue; and where a field is badly infested this yellow "sickly" aspect is perceptible from a distance. On examining the withered plants, the worm, or flax seed if it has advanced to that stage, can be readily found. It is situated a short distance below the surface of the earth, at the crown of the root, (fig. A. §). One or two radical leaves start from this point, their bases forming a cylindrical sheath around the central or main shoot, which as yet is but in its infancy. It is within this sheath, at its base, that the worms repose, one, two, three, or more, and by imbibing the nutritious juices of the young shoot, cause it to wither and die. The mechanical pressure of the larvæ, so frequently spoken of as impeding the circulation of the fluids of the plant, and hereby causing it to perish, I think has had too much importance assigned to it, the young plants being so soft and pliant that they would readily accommodate themselves to this pressure, if they received no molestation beyond this.

Is the crop ever benefitted by it?—The vigor and luxuriance of the uninjured shoots from the same root, contrasts so strongly with the wilted and feeble appearance of those attacked by the worm, as to have led some to believe that the unaffected shoots were stimulated to a more rapid and robust growth in consequence of the *pruning* given by the fly; and that a better crop is thus sometimes produced, by the presence of a moderate number of these worms among the wheat plants. The correctness of this opinion we very much doubt. The worm is nourished and reared upon those very fluids that are absorbed by the plant and elaborated for its own sustenance and growth. Every particle of this nutritious juice, therefore, that is consumed by the worm, is a direct loss of just so much material that would otherwise become straw and grain. At all events, we think our farmers generally will prefer that nature should be left to her own undisturbed course in rearing their wheat plants, and will be by no means solicitous to have this renowned guest take any part in the operation.

Its change to a "flax seed" or dormant larva.—When the worm, or active larva, has fully completed its growth, a slight diminution in the dimensions of the inner soft parts of its body commences, in which the outer and harder skin does not participate, this latter retaining its original full size. The result of this contraction is, that the worm gradually cleaves from its outer skin. If examined with a microscope when this change has recently commenced, a slight translucent space is observable at the head end, and a larger and more obvious one at the pointed or tail end, plainly indicating that the enclosed worm does not entirely fill its outer skin. This contraction continues, until the worm becomes entirely separated from its outer skin, and lies within it like the finger within a glove. The outer skin at the same time changes in color. From its original whiteness and transparency, it gradually becomes opaque, brown, and finally of a dark bay or chestnut color. Though *much less flat* than a flax seed, its resemblance in color, size, and form, to that familiar object, is so striking as at once to be remarked by every one.

Characters of the flax seed, or larva case.—Different specimens of these flax seed like larva cases (fig. *h. i. j.*) vary in length from 0.13 to 0.19 and in breadth from 0.05 to 0.08. They are shining, cylindrical-oval, more obtusely rounded at the lower or head end than at the other, which is generally attenuated into an acuminate point or small projecting papilla. They are commonly composed of but nine obvious segments, and these are but slightly indicated by very faint acutely impressed transverse striæ—a similar transverse stria, but still more faint, being sometimes perceptible (fig. *h.*) across the middle of some of the segments. Longitudinal impressed striæ are sometimes present, (fig. *j.*) more conspicuous than the transverse and reaching a part or the whole length of the worm; and between these the surface is minutely acuducted (i. e. appearing as if lightly scratched by the fine point of a needle) longitudinally—all these longitudinal impressions being perhaps caused by the pressure of the veins and fibres of the plant, against which the worm has been imbedded. On the under side, (fig. *i.*) towards the head end, the case is flattened, as if pinched together, so much so that the anterior segment seems a mere empty fold of the membrane, without any inflation sufficient to make room for internal

viscera. At this end is often observable one or two little brush-like granules, resembling those on the soles of the feet of some carabidous insects. (One of these is indicated on the anterior edge of fig. *i*.) Are these the relics of the suctorial mouth of the larva? This larva case is comparatively tough and leather-like at first, but becomes more brittle and also darker with age.

Characters of the dormant larva.—On carefully opening the larva case just described, a worm (fig. *k*.) is found within it, scarcely different in any respect from what it was immediately before entering upon this flax seed state. It has the same oval form, opake milk-white color, and green, cloud-like visceral spot or line beneath. The nine segments into which it appears divided, however, are now much more distinctly marked than they previously were, the transverse lines being more deeply impressed, and the margins showing corresponding crenatures. No traces of the members of the future fly are yet discernable. The insect now undergoes no further change, for a period of five months or more. Enveloped in its flax seed like mantle, and reposing at the root of the now lifeless grain, it is buried beneath the snows of winter. Over one-half of its entire term of life is therefore passed in this state.

Error in previous accounts.—This is the stage of this insect, which has been spoken of by all preceding writers as its pupa or crýsalis state. Upon a close observation of *Cecidomyia tritici*, the writer succeeded in discovering that that species had, what some had conjectured, but none had actually observed, a regular pupa form, identical with that of other species of *Cecidomyia*, whose metamorphoses had been fully described. It hence appeared necessary to distinctly mark that long period of inactivity which intervenes in the wheat-fly, after the larva has completed its growth, and before it enters its pupa state; it was therefore, during this state of its life denominated a dormant larva, in my essay upon that species. It occurred to me whilst writing out that essay, that the dormant larva state of the wheat-fly, was exactly analogous to the flax seed state of the Hessian fly, and in a note, my suspicions were expressed that the real pupa of the Hessian fly had never been detected. The ample opportunities which I have since enjoyed for investigating

this species, have enabled me fully to trace out this point in its transformations, and to show that it is not till near the close of its flax seed period of existence that the Hessian fly puts on its pupa form. In penning the note just alluded to, I had overlooked a passage in Mr. Herrick's last paper, from which it is obvious that he has seen the real pupa of the Hessian fly, although he still speaks of its pupa state as commencing when the worm becomes a flax-seed. Inaccuracies of this kind, which to the general reader appear so trivial as scarcely to require correcting, are liable to lead to important errors. Of this, we have a striking illustration in this very instance. Mr. Westwood, on opening the flax seeds contained in the wheat straw from Germany, came upon "the larva," where, according to all the accounts of the Hessian fly he ought to have found *the pupa*; he therefore at once draws the important inference, that the German insect cannot be the Hessian fly of America. Indeed it is surprising, that so plain a fact as this, that it is a worm and not a pupa which is enveloped in the flax seed case of our insect, has been so wholly overlooked by every one who has hitherto written upon this subject.

THE PUPA. *When formed.*—On the access of the first warm days of spring, as soon as the weather becomes sufficiently genial for some of our earliest plants to put forth their blossoms, the larva of the Hessian fly is rapidly stimulated to maturity. The present year, so early as the 21st of April, most of the insects were found to have taken on their pupa form. As this season was more forward than usual, this may prove to be an earlier date than is common for this occurrence; a more accurate criterion by which to indicate it definitely, is no doubt by a reference to the progress which vegetation has made at this time. We may therefore state, that in all parts of our country, the Hessian fly will probably be found in its fully formed pupa state, about a week after the liverwort, (*Hepatica triloba*), the trailing arbutus (*Epigaea repens*), and the red or swamp maple (*Acer rubrum*), first appear in bloom, and simultaneously with the flowering of the dry strawberry (*Comaropsis fragarioides*), the common five-finger (*Potentilla canadensis*), the hill-side violet (*Viola ovata*), &c. It continues in this state about ten or twelve days, and then sends out the winged fly.

Its characters.—The flax seed shell has now become quite brittle, breaking asunder transversely if rudely handled, and one of its ends slipping off from the inclosed pupa like a thimble from the end of the finger. On removing the pupa (fig. *l.*) from its case, it is found to be 0.13 long by 0.05 broad, of an oval form, with rounded ends, and having its limbs and body enveloped in separate membranes. The thoracic portion is slightly narrower than the abdominal. The wings do not quite attain the middle of the length of the body. The outer pair of feet come out from under the tips of the wings, and reach to the anterior margin of the penultimate abdominal segment, slightly curving inwards at their tips. The next pair of feet are somewhat shorter, and the inner pair are shorter still. They all lie in contact with each other, and in a direction parallel with the body. The abdominal segments are distinctly marked by strongly impressed transverse lines, and are of a milk-white color, the thorax and head being of a delicate pale pink-red, and the feet translucent-white. On the anterior margin is a chestnut-brown crescentiform mark. It will hence be perceived, that in all the details of its form, the pupa of the Hessian fly coincides precisely with those of the other species of this genus which have been described.

Its change into a fly.—The time for its final transformation having arrived, the pupa breaks open and crawls from its puparium or flax seed case, and works its way upwards within the sheath of the leaf, until it arrives at some cleft in the now dead, brittle and elastic straw ; through this cleft it gradually, by bending from side to side, crowds its body until all except the tip of the abdomen is protruded into the air, the elasticity of the straw causing it to close together upon the tip of the abdomen, so much as to hold the pupa in this situation, secure from falling to the ground ; and as if to preserve the body in a horizontal position, the feet are slightly separated from the abdomen, and directed obliquely downwards, with their tips pressed against the side of the straw, thus curiously serving, like the brace to the arms of a sign post, to support the body from inclining downwards. Thus securely fixed, and now freely exposed to the drying influence of the atmosphere, the outer membrane of the pupa speedily exhales its moisture, and as it becomes dried, cracks apart upon the back part of the thorax ; out of this cleft the inclosed fly protrudes its head and thorax more and more, as it gra-

dually withdraws its several members, the antennæ, wings and legs, from the cases in which they are respectively enveloped—a process analogous to that of withdrawing the hand and its several fingers from a tight glove; until at length entirely freed, the now full-fledged and perfectly formed fly leaves its pupa skin and mounts into the air.

Peculiarity in its metamorphoses.—It is sufficiently apparent from the account that has now been given, that the Hessian fly differs notably from all its congeners in one important point in its transformations. From all the observations that have been hitherto made, the cecidomyians correspond with the other tipulides in this prominent particular—that their pupæ are naked. Other species, at least many of them, after completing their growth, cleave from their skins in the same manner that the Hessian fly does, but when the separation is formed, the inclosed worm invariably crawls from and forsakes its larva case. It is thus, even, contrary to what has been hitherto supposed, with the *C. tritici*. Since my essay upon that species was published, I have clearly ascertained that the mature or dormant larva does cast its skin. Indeed, this fact is distinctly related by Dr. Harris, in his treatise, to whom is due the credit of having first announced it. His statement had escaped my observation when previously alluding to this subject. So far as I am aware, moreover, the cast skins in the several species are translucent, and of a membranous texture. In the Hessian fly, however, it becomes opaque, changes its color, and is of a firm or coriaceous texture. The inclosed worm, also, does not leave it, but remaining, eventually changes within it to a pupa, the same case thus forming its puparium. Its metamorphosis thus approximates it to the Muscidæ or true flies, the Stratiomidæ or soldier-flies, &c., and its pupa, in technical language is “coarctate” and not “incomplete,” like the pupæ of the other cecidomyians. Should usage, therefore, settle down upon the name *midge* as distinctive of the minute tipulides, there will still be a marked propriety in continuing to this species its old name, Hessian fly.*

* I doubt, however, whether the Hessian fly will continue to be the sole member of this genus having a coarctate pupa. Quite recently a species has occurred to my notice, analogous to the Hessian fly flax seed in every point that I have been able to

THE FLY. *Its Characters.*—In the female, (fig. 3,) the *head* is flattened globular, and black throughout. The *antennæ* (fig. e,) are about half as long as the body, and composed of sixteen joints, each of a cylindric-oval form, the length being about double the diameter; each joint is clothed with a number of hairs, of which those towards its base are slightly more robust and longer, about equaling the joint in their length, and surrounding it in a whirl. The joints are separated from each other by very short translucent filaments, having a diameter about a third as great as the joints themselves. The terminal joint is at least a third longer than the preceding ones. The two basal joints of each antenna are globular, and compact or not separated by an intervening filament, and exceed the following joints in diameter. The *palpi* (fig. f,) consist of three obvious joints, clothed with very short minute hairs. The two last joints are cylindrical, nearly equal in size, and about twice as long as broad: the basal joint is more short and thick. The *thorax* is oval, broadest immediately back of the wing sockets, and black. The *scutel* is of the same color, projecting, and slightly polished, with the suture surrounding it sometimes fulvous. The *poisers* are dusky. The *abdomen* is elongate-ovate, its broadest part scarcely equalling the thorax in diameter; it is of a black color above, more or less widely marked at the sutures with tawny-fulvous, and furnished with numerous fine blackish hairs. The *ovipositor* is rose-red, and slightly exerted commonly in the dead specimen; it is susceptible of being protruded to a third of the length of the abdomen. The *wings* are slightly dusky, and fulvous at their insertion into the thorax. Their form and neuration is identical with that of the other species of this genus, except that the slight connecting nerve between the mediastinal and postcostal is commonly wanting, and the medial and forks of the anal nerves are extremely faint for a species of *Cecidomyia* so large as this. The legs are

detect, except that its larva case is of a pale brown color, untinged with rufous or castaneous. It infests the *Agrostis lateriflora*?, numbers dwelling together in an imbricated gall, somewhat resembling the fertile aments of the hop, though larger, and connected with the main stalk by a short pedicel which is inserted into one of the lowest joints of the culm. From the coriaceous texture of the larva case, I suspect the inclosed worm will not leave it, until transformed to a pupa and upon the point of evolving the perfect fly.

pallid brown, the tarsi black, the femurs paler at their bases. The several pairs of legs equal each other in length, being about 0.24 long when extended, of which length the tarsus embraces one-half. The several joints of the tarsus are of the same relative length as in other species; the short basal joint however, is much more indistinct than usual, insomuch that a minute examination of several specimens is required ere one is met with showing this joint distinctly.* This character, and also the neuration of the wings, clearly shows that this species belongs to the genus *Cecidomyia*, and not to Macquart's genus *Lestremia*, nor Meigen's *Lasioptera*.

In the male, the *antennæ* (fig. d,) are three-fourths of the length of the body, with the joints of a short oval and nearly globular form, the diameter hardly equalling the length: each joint is surrounded with a verticil of longish hairs. The terminal joint does not differ from the preceding ones. The two basal joints are compacted together as in the female. The *antennæ* diminish very slightly in diameter towards their tips. The filaments separating the joints are smoky-translucent, nearly as long as the joints, and about one-third of their diameter. The *abdomen* (fig. 2,) is cylindric or slightly tapering towards its tip, and consists of seven joints beside the terminal one, which (viewed from beneath, vide fig. c,) consists of a transversely oval joint, giving off two robust processes, armed with incurved hooks at their tips; and between these processes at their base are two exceedingly minute papillæ. As ordinarily seen, in the living specimen, the abdomen is of a brownish-black color, more or less widely marked at the sutures with pallid fulvous or smoky whitish lines. In all other points the male coincides with the female in its characters.

Its duration.—That the fly which comes out in the spring continues but a very short time, I infer from the following data. A number of wheat plants, containing pupæ, were transplanted into a box of earth, April 21st, and inspected daily. On the morning of May 1st, about half of them were found to have sent out the perfect fly

* How well the engraver has executed his task will be obvious by passing a magnifier over the plate. The joints of the tarsi in fig. 3, and other minute details, scarcely, if at all perceptible to the naked eye, will then be distinctly recognised.

within the preceding twenty-four hours. On repairing to the field whence these plants were taken, the fly was found to be out in large numbers. At every step, a dozen or more would arise from their coverts, sluggishly fly a few feet, and alight again. In other fields, where none of the flax seeds could previously be found, an occasional fly was met with, on the same day. A week after this, on a thorough examination, no flies could be found, nor were but two specimens afterwards met with, until the coming out of the summer brood.

Second Generation.

After the full details that have already been given, but a few words will be required under this head. About the first of May the fly appears, and deposits its eggs upon the same crop of grain that has already reared one brood, and also upon any spring wheat that is sufficiently forward for its purposes. The radical leaves of the winter wheat are now more or less withered, and the fly therefore selects the more luxuriant leaves that have put forth above these. The worm hatches, and again makes its short journey to its future home, at the base of the sheath; it consequently now nestles at the first and second joints of the young stalk, and is sometimes, though rarely, as high as the third joint. Even before the worm reaches the base of the sheath, it has frequently grown nearly to its full size, (as shown, fig. *m.*). The stalk has now attained such vigor and hardness that it is seldom destroyed by this spring attack. A slight swelling, immediately above the joint, (fig. B. §§,) commonly indicates the presence of the larva beneath. This is a fact which has been overlooked, or at least not distinctly stated by writers hitherto. We only find it noticed by Mr. Bergen, (*Cultivator*, viii., 133,) who informs us that in a crop of barley which was destroyed by the Hessian fly, many of the stalks were "at the joints as thick as a man's finger." The insect is therefore a true *gall-fly*, although when but one larva succeeds in reaching the joint, the swelling caused by it is but little if at all apparent. More commonly however, the straw becomes so weakened, that it is unable to sustain the weight of the wheat head, and it accordingly bends down (as represented, fig. B††,) with the force of the wind and rains. The appearance of a badly infested field, as harvest time approaches, cannot better be

described than in the words of M. Köllar. The grain looks as though a herd of cattle had passed through it, so broken and tangled together is the straw. The worm attains its growth and enters its flax seed state about the first of June, and the flies of this second generation commonly come forth about the last of July and in August.

Miss Morris's theory.—We do not deem it necessary to go into a detailed examination of the theory revived by Miss Morris in 1840, that the eggs of the Hessian fly are deposited in the grain, and that the larva lies in the centre of the culm. We suppose this theory to be abandoned by its late advocates, from the fact that for four years past, we have met with no farther attempts to sustain it. To us it appears manifest that the lady was widely misled at the very outset of her observations by an error in Mr. Say's account, to wit, that "the perfect fly appears early in June." Were this the case, she might well enquire, "Where are the eggs placed? Surely not in the old and dying stalk . . . and there is no young wheat growing from June until September." The flies which Miss M. saw in June, 1836, "in countless numbers, hovering over and settling on the ears of wheat," we cannot but suspect were the same species which in this section of country appears in such swarms upon the heads of wheat about the middle of June, that it has been for years mistaken hereabouts for the wheat-fly or midge, (vide *Transactions N. Y. State Agr. Soc.*, vol. v., p. 260 and 267). In size and color it does closely resemble the Hessian fly, and might readily mislead any one just commencing their observations. That occasional specimens of the Hessian fly may be taken in June we do not doubt; but that the main brood comes out, deposits its eggs, and disappears, a month earlier than this, we are quite confident, from our own observations as already related, as well as from the testimony of almost every writer who speaks definitely upon this point. Those few larvæ which have been found in the centre of the wheat culm, were not unlikely of some other species, since in this particular its habits correspond with those of the *Cephus pygmaeus*, the *Chlorops pumilio-nis*, &c. That the Hessian fly larva resides in the sheath of the culm, and not in its centre, we feel confident Miss M. has herself become convinced ere this day:—so earnest and candid an enquirer

after truth, and one so capable of giving to every fact its due weight, cannot long remain in error, upon a point so susceptible of demonstration as this.

Its Parasites.

It is well known that one of the most effectual means for keeping the Hessian fly in check and preventing it from literally *swarming* all over our land, has been provided by nature herself. Other insects have been created, apparently for the very purpose of preying upon this, and thus preventing it from becoming inordinately multiplied. The world is indebted to Mr. Herrick for much interesting information respecting these insects, the result of his own accurate and patient investigations. As we purpose, should we succeed in more fully tracing out the history of these and other Cecidomyian parasites, making them a subject of a separate memoir at some future day, we refrain from devoting to them any considerable space in the present paper. The general reader, however, will scarcely pardon us, if we omit all allusion to them. We therefore subjoin a brief sketch of the contents of this part of Mr. Herrick's article.

The Hessian fly is preyed upon and devoured by at least four other insects. When its eggs are layed upon the wheat leaves, they are visited by an exceedingly minute four winged fly, (a species of *Platygaster*,) which punctures the egg and deposits in it four or six eggs of its own; the Hessian fly worm hatches, grows, and passes into its flax seed state with these internal foes feeding upon it: it now dies, and its destroyers in due time escape from the flax seed shell. Three other minute four winged flies, or bees as they would be called in common language, destroy the fly when in its flax seed state. The most common of these, by far, is Say's *Ceraphron destructor*. Alighting upon the wheat stalks, instinct informs them precisely where one of these flax seeds lies concealed. They thereupon "sting" through the sheath of the stalk, and into the body of the worm, placing an egg therein, which hatches to a maggot, lives upon and devours the worm. Such are the means which nature has provided for preventing this pest from becoming unduly multiplied. And so efficient and inveterate are these foes, that more than nine-tenths of all the Hessian fly larvæ that have come

into existence, are probably destroyed by them, Mr. Herrick thinks, and we have strong reasons for believing that his estimate is within the truth.

From the date given by Mr. Herrick of his first discovery of the egg parasite, we know that the first or autumnal generation is attacked by it. Whether it preys upon the second or spring generation also, does not so clearly appear. From our own observations, and the well known habits of the other parasites, it would seem to be principally upon the second or spring generation which they prey. Indeed we can scarcely conceive it possible for them with their short ovipositors to reach the flax seeds of the first generation, buried as these are beneath the surface of the earth and reposing at the roots of the young wheat. That these parasites are surprisingly abundant, and destroy immense numbers of the spring generation, any one can easily ascertain by collecting the infested straw at harvest time, and securely enclosing it, to preserve all the insects which hatch from it. He will thus obtain parasites in abundance, and only occasionally a Hessian fly. On the other hand, numbers of the young plants taken up by us in April, evolved nothing but Hessian flies. The observations of a single season, we are aware, cannot be relied on for establishing a point like this. But they force upon us the suspicion that it is chiefly the second generation that is infested by parasites, and that the first is comparatively free from them.

Remedies.

“An *effectual remedy*” against the Hessian fly, which has been so much inquired after and talked about, and by which term we suppose is meant some *specific* which will infallibly destroy or drive away the insect, or protect the crop from its ravages, never has been and probably never will be discovered. In truth, we regard the idea that a remedy of this character exists, as being equally absurd with a belief in the philosopher’s stone. There is probably no such thing as sure and infallible specifics against any of the insects which invade our crops, any more than there is against those diseases which attack our persons. Still, believing this, we also believe that there is no noxious insect but what, when we closely study into its habits we can invariably discover some one or more ways of opposing it, by

which we can with certainty to a great extent, if not entirely, shield ourselves against its depredations. Thus it is with the insect under consideration. There is no remedy with which we can "doctor" it away—no charm with which we can say to it, "vanish presto;" yet there are measures, which employed, will guaranty fair crops, when if not resorted to, no wheat will be gathered. Of this fact we are well convinced, both from personal observations, and the concurrent testimony of a cloud of witnesses.

A consideration of the various remedial measures which have been proposed, is therefore a subject of surpassing interest to every cultivator of the soil. We shall hence proceed to review them in detail, treating first of those, which, after a careful consideration of this topic, we regard as the most important.

1. *A rich soil.*—This is a safeguard which has been strongly urged by almost every one who has written upon this insect. Indeed an inspection of different fields of wheat in a district where this enemy is present, cannot fail to impress upon the observer the utility and importance of this requisite. Other things being equal, the crops on impoverished lands invariably suffer the most. Hence those on sandy soils, which retain the strength of fertilizing agents less than other soils, have in numerous instances been remarked as most severely devastated. A striking contrast, even, may very often be perceived in different parts of the same field. The summits of the knolls and ridges, situations where the soil is the most meagre, almost invariably show the greatest amount of damage; whilst the intervening hollows, to which the fertilizing matters are washed from the surrounding acclivities, sustain a comparatively slight if at all sensible injury. Yet the latter situations are the very ones which insects of this family are known to be most prone to frequent, being more low, shady and damp. There can be no doubt, therefore, but the fly is as numerous in the hollows of a grain field, as upon its ridges; and that it is only in consequence of the greater fertility of the former situations, that the crop there, is enabled so effectually to withstand this enemy. Indeed, the farmers themselves, in districts where the fly has prevailed, have all learned from experience, that it is only upon fertile lands that it will do to sow their wheat. Hence Ezra L'Hommedieu long ago intimated that the

Hessian fly on Long Island, by driving the farmers to manure their lands, instead of a curse had actually been *a blessing*. He says, "the land in Suffolk county and other parts of Long Island, was easily tilled, and by continual cropping with wheat was so reduced, that on an average not more than five or six bushels was raised to the acre. This mode of husbandry was still pursued, and although the land was gradually impoverished, the farmer found the crop, although small, more than would pay for his labor and expense. The Hessian fly put an end to this kind of husbandry, and in that respect has proved a blessing instead of a curse; no other way being found to prevent the injury done by this insect, but by highly manuring the land." (*Trans. N. Y. Soc. for Prom. of Agric., &c., i. 57*). A writer in Delaware also states that the universal predilection there, was to have *large* rather than *rich* fields of wheat; that this insect was counteracting this, by compelling them to cultivate less land, in order to cultivate it well; and that its tendency consequently was, to make our population more dense, by making it the interest of every man to own no more land than what he could manure highly and till carefully. (*Carey's Museum, xi. 301*). We thus have, even in the devastations committed by this destroyer evident indications of that

"All partial evil, universal good,"

which is every where manifest in the works of the Supreme Architect of nature. It is doubtless the additional strength and vigor enjoyed by plants growing upon a rich soil, which enables them to withstand the depredations of this insect. Those shoots which are first sent up from a kernel of seed, are the ones which are commonly attacked and destroyed, and in an impoverished soil the seed itself thereupon perishes; whilst in a rich soil, its vitality continues, and other shoots are sent forth by it, which grow vigorously and unmolested. In the spring attack also, the weak and slender stalks growing upon a poor soil, are much more liable to become broken and fail of maturing any grain, than the large, robust, well nourished stalks of a fertile soil. Hence a rich soil enables a plant to elaborate a sufficient amount of fluids for its own sustenance, in addition to that which is abstracted from it by a few of these insects. We therefore regard this as a primary and indispensable measure, and one which must accompany others next to be considered, in order to their full success.

2. *Late Sowing*.—This measure also comes to us sanctioned by the almost unanimous recommendations of writers; and we regard it as one of the most efficient, as it certainly is the most facile of any that can be resorted to. It is universally admitted that it is the earliest sowed fields that are always the most infested; and we cannot but suspect that the present visit of this enemy to this section of the country, after so long an absence, has been invited by the general practice of early sowing, resorted to by our farmers under the probably incorrect idea of hereby escaping from the depredations of the wheat-fly. Just before harvest, our attention was directed to two contiguous fields of wheat in the town of Stillwater, one of which was seriously injured by the Hessian fly, whilst in the other not a solitary straw broken by the insect could be found. The only cause to which this striking contrast could be imputed, was, that the latter field had been sowed a fortnight later than the former one. Analogous instances have often occurred to the notice of every observing person living in districts where the fly has been present. Such cases, however, must not be deemed to prove so much as they at first view appear to. It is not probable that the fly had entirely ceased from depositing its eggs before the second of the above fields had become forward enough for its purposes. Had the sowing of the first field been delayed a fortnight, both fields, it is probable, would have suffered equally. The whole injury that fell upon the first field, would thus have been divided between it and its neighbor. And so in all cases, we presume that the field which is the earliest, attracts all of the insects in its immediate vicinity, and these finding all the accommodations they desire there, have no occasion for going elsewhere. For a more extended elucidation of this topic, see the *American Farmer*, vol. ii. p. 167. Two objections have been urged against late sowing; the liability of the young plants to "winter-kill," and of the crop when near maturity to be attacked by "the rust." There is little danger of the first of these casualties, we suppose, upon porous soils, it being a disaster almost peculiar to stiff clays, which retain a large amount of moisture at their surface. In such soils, therefore, it may be advisable to resort to the plan employed in some parts of England, namely, sowing only on a newly turned over sward, the grass roots in which

serve to bind the soil together in such a manner as to retard its "heaving" by the frost. (*Fessenden's Complete Farmer*, p. 114), This disaster, moreover, is guarded against in a great degree by sowing only upon a very fertile soil, whereby a quick and vigorous growth is secured, and the young plants are thus enabled to acquire sufficient strength of root to withstand the winter's frosts. The same expedient, also, by insuring a rapid growth and an early maturity of the crop is the best safeguard against the rust, a disaster to which late crops only are ordinarily liable. Upon rich land, therefore, scarcely any scruples need be entertained with regard to late sowing. If a neighboring field has been already sowed and the season is favorable for its vegetation, it will be safe to commit the seed to the ground within a week or two thereafter, as all the insects in the vicinity, unless they are present in immense swarms, will be attracted to and remain in the earlier crop. About the last of September is probably as late as it will be judicious to defer sowing wheat in this climate; and in most seasons this will secure it from any serious attack of the fly. Although when it comes forward, the season for the deposition of the eggs of the fly may not in some years be entirely over, it must be rare that a number of these sufficiently large to be materially injurious, will be laid; but should that at any time be the case, other remedies still can thereupon be resorted to, to counteract the evil.

3. *Grazing*.—This measure is alluded to as worthy of attention, in the first account of this insect published in this country, where the fact is stated, that "by feeding the crop very close in the winter and spring, if the land is rich it will again spring up, and the worms do not much injure the second growth." It is plain that a close fed crop will furnish few leaves for the fly to place its eggs upon, and these leaves will be commonly consumed before the eggs are hatched. Gen. Cocke directed public attention strongly to this measure in 1817, and six years subsequently states that full experience had amply confirmed him in his estimate of its efficacy.—(*American Farmer*, v. 241). If in autumn it be omitted till after the eggs are hatched, and the worms have descended to the root, it can obviously be of little or no service. When, therefore, an attack of the fly is feared, as the exact time of the deposition of the eggs is somewhat variable in different seasons, it will be necessary to

watch the young wheat, as soon as two or three blades from each root appear; and if the fly is discovered profusely depositing its eggs, sheep or other stock should at once be turned upon it, in such numbers, if possible, as to eat down the crop in a few days. The eggs will thus be destroyed, and the favorite nidus of the fly for continuing this deposite, will be effectually broken up: it will thus be compelled to resort to other quarters. The same process may also be repeated in the spring, if found necessary. No injury to the crop need be apprehended from its being thus grazed down, if the soil is of due fertility—it soon and entirely recovers from this operation. Moreover, if the soil is poor and impoverished, the fly will be sure to injure it far more than what the sheep will do. We cannot, therefore, but regard this as a most judicious and important measure, if seasonably resorted to. The intelligent wool grower, will scarcely require to be informed, that sheep taken from their ordinary walks, should at first remain upon the rank feed of the wheat field but an hour or two of a day.

4. *The roller*.—Passing over the grain with a heavy roller, is a remedy in commendation of which several writers concur, supposing that many of the eggs upon the leaves will thus be crushed. Col. Morgan was in the habit of both rolling and grazing his wheat fields, before the Hessian fly appeared in his vicinity; and as his crops were much less injured than those of his immediate neighbors, he attributes his escape to these causes. If there be any foundation for Mr. Smeltzer's opinion, that certain varieties of wheat are fly proof, because their leaves grow horizontally instead of inclining upwards, assuredly by a repeated use of the roller every kind of wheat may be made fly proof. No doubt this measure is a judicious one, particularly on fields that are so smooth and free from stones that almost every plant will receive a firm pressure by the operation. If resorted to, it should obviously be done at those times when the eggs are newly laid upon the leaves. After all, is not the efficacy of the roller, at least in part, owing to its loosening and dislodging the eggs from their position and causing them to drop to the ground, where the worm, hatching, is unable to find its way into the sheath of the young plant? This point merits investigation; for if there is any truth in the suggestion, sweeping the plants with a broom or

some similar implement, will probably brush off much greater numbers of the eggs than passing a roller over them can do.

5. *Mowing*.—Mr. Goodhue, of Lancaster, Wisconsin, in a communication in the fifth volume of the *Prairie Farmer*, suggests that the larvæ concealed within the bases of the leaves, may be destroyed by mowing the wheat, and feeding it to the stock. We deem this proposal a valuable one for exterminating the second or spring brood from a wheat field. In those cases where the worms are discovered in the month of May, to be fearfully numerous at the joints of the young stalks, there can be little doubt but that on smooth grounds the scythe may be so used as to take off almost every spear below where the larvæ are lodged; and that thus a second growth of stalks will be produced, quite free from these depredators. The following facts incline me to believe that on a fertile soil, wheat may be thus mowed, with little if any eventual injury to the crop. Portions of a field of my own, the past season grew so rank, that deeming it would become lodged and mildewed, by way of experiment a space in it was mowed down after the plants were two feet in height, and another after the heads had begun to put forth. Though not so early in ripening, the appearance of these two patches at harvest, indicated, so far as a single experiment could do, that wheat might be mowed at the former period without any diminution of its productiveness, whilst at the latter, both the straw and heads would be of a more slender and feeble growth.

6. *Fly proof wheats*.—That there are any kinds of wheat which are perfectly “fly proof,” (to use a common and expressive term,) as has been sometimes stated, we wholly disbelieve. At times when the fly is so excessively numerous as to attack barley and rye, it is not probable that any of the cultivated species of the genus *Triticum* can entirely withstand its attacks. But that there are kinds of this grain, that escape with little injury, when other kinds are almost wholly destroyed, is a well established fact. What the peculiar properties possessed by these varieties are, that render them thus singularly invulnerable, has never been investigated with that degree of accuracy, which so interesting and important a subject well merits. Mr. Worth supposes that fly proof wheats must have smooth leaves, affording no grooved or channelled surface to hold

the eggs of the fly. (*Amer. Far*, ii. 181). Mr. Smeltzer thinks the leaves of such wheat stand out horizontally from the stem, or incline downwards, instead of being erect, and that the egg is thus washed to the ground by rains. (*Patent Off. Report*, 1844, p. 434). The Hon. J. Taliaferro regards the immunity as proceeding from the strength and vigor of the roots, whereby the plant continues to grow, notwithstanding the exhaustion of its juices by the worm. (*Patent Off. Report*, 1842, App. No. 1). This theory appears to us more plausible and more in accordance with the facts recorded with regard to these varieties, than any other which has been proposed. Other opinions less specific, might be alluded to, but all of them are opinions merely, as we discover no evidence of their having been substantiated by a diligent investigation of this point. The reputation of the UNDERHILL WHEAT has already been sufficiently shown. This was a bearded white chaff, with a plump yellow berry, requiring to be thoroughly dried before grinding, and then producing flour in quantity and quality equal to the best of the other varieties. Its fly proof quality was by many supposed to be owing to the hardness or solidity of its straw. The fly freely deposited its eggs upon this wheat, but it was seldom, if ever, materially injured by it. The SPELTER WHEAT (*Triticum spelta*, Linn.) was also long since remarked as never having been injured by the fly. This is so very inferior a species, that it is but little in use in this country, and only cultivated because it will grow well on the poorest soils, whether the season be wet or dry, and is free from all maladies. It has a long, slender, beardless head, with the chaff so firmly attached to the grain, that it can only be separated by passing through a mill, and yields a yellowish flour. It is more highly esteemed in Germany than in any other country, being there preferred even to all other kinds of wheat. The CHINA WHEAT, said originally to have been found in a crate of imported China ware, branches and grows very much like rye, ripens at least a week earlier than other varieties, yields largely, (forty or fifty bushels per acre it is said,) and has never been known to be injured by the fly. (*Pat. Off. Report*, 1844, p. 43). The MEDITERRANEAN WHEAT, in such high repute for its fly proof and other qualities, was introduced into Maryland in 1837. It is a slight red chaff, having a long stiff beard, a long, red, and very flinty berry, and ripens about ten days earlier than

other varieties. Mr. Garnett, in his Fredericksburg address, considers its only title to be designated as fly proof, is, that it recovers better than other wheats from the depredations of this insect. In the *South. Planter*, (vol. ii. p. 243,) it is said to be a coarse, dark grain, much like rye, and yielding such indifferent flour, that some of the merchants had announced they would buy no more of it. Its straw too, when grown upon a fertile soil is said to be too weak to support the head. Mr. R. L. Wright, in the *American Agriculturist* of 1843, and others, state that it improves by cultivation. As it becomes fully acclimated, it will, we doubt not, lose its most objectionable traits; but will it not with them also lose its fly proof and other qualities, which are its main recommendations at present? On the whole, this variety is so very prolific, and so exempt from all diseases, that we are not surprised at the marked favor it has received. It is admirably adapted for securing a premium in our agricultural societies, where, "the largest crop, raised at the least expense" receives the prize; but its grower will be reluctant to inform his neighbors, that he sells it in market at six cents per bushel under the current price. In fine, we think this noted variety can never come into general favor in those districts where choicer kinds can be successfully cultivated. The ETRURIAN WHEAT, brought home by Com. Stewart, so far as yet appears, possesses all the most valuable qualities, and none of the defects of the Mediterranean. This is a bald variety, having a strong and vigorous stalk, a beautiful long smooth head, yielding a round plump, white kernel, with a remarkably thin bran. It is very prolific, and quite as early as the Mediterranean, (Rev. D. Zollickoffer and others in the *American Farmer*,) and has thus far resisted the attack of the fly. We are gravely told by an anonymous writer, that "this wheat was not, as its name would indicate, brought from the little Island of Etruria." In what creek this "little island" is situated, we have been unable to discover, but with such a decided negation, we are driven to the inference that the grain in question was derived from a territory which we *moderns* call Tuscany. The WHITE FLINT WHEAT, one of the choicest varieties of western New-York, withstands the attack of the fly better than any of the other kinds there in use. For a full account of it, see Gen. Harmon's paper in the *Trans. N. Y. State Agric. Soc.*, 1843, p. 217. In conclusion of this branch of our

subject, we would observe, that we should by no means be solicitous of procuring any variety of wheat, *merely* because of its fly proof qualities, believing as we do, that in all ordinary visitations of the fly, other measures are a sufficient safeguard. If vigor of root, firmness of stalk, and rapidity of growth, are, as would appear, the points which render these varieties fly proof, a fertile soil will certainly go far towards imparting to most other varieties the same quality.

7. *Steeps for the seed.*—These have been recommended with a two-fold view. 1st. To destroy the eggs; decoction of elder, juice of elder, boiling water, &c. These assume the erroneous position that the eggs of the fly are deposited upon the grain; it is manifest therefore that they can be of no utility. 2d. To insure a quick and vigorous growth of the young plant. Where sowing is deferred until late in the season, it may be judicious to resort to some measure of this kind to stimulate the seed to a more speedy and rapid germination and growth. In *Carey's Museum*, (vol. xii. page 182,) an experiment of a Poughkeepsie farmer is related, who had soaked his seed wheat in a solution of saltpetre, four ounces being dissolved in water sufficient to wet a bushel. After soaking twenty-four hours, it was spread out and dried twelve hours, and then sowed, so late as the first of November. Early in the following June, this crop is reported as being in advance of neighboring ones which had been sowed early. This experiment, and others of a similar character, strikingly indicate that it lies much within the compass of human instrumentality to accelerate the growth of vegetation, by measures of this kind.

8. *Oats as a decoy.*—It has been recommended, to furnish a crop of young or of "volunteer" oats to the insect, on which to deposit its eggs; and when it has nearly or quite completed this operation, plowing the oats under, thus burying the eggs and larvæ, and then sowing the wheat upon their graves. To us, this appears only as "a tub to amuse the whale;" or in other words, an admirable project for wheedling honest "Farmer John" into late sowing, upon an enriched well pulverized soil. We have no clear evidence that the fly will deposite its eggs upon oats. It certainly will not be inclined to do so if there is any young wheat, barley, or rye in the vicinity to which it can resort.

9. *Wheat as a decoy.*—The preceding measure suggests to us another, which is well worthy of the attention of the agriculturist. The facts recorded respecting this insect, clearly show that it is the earliest sowed and most forward fields of grain that are most infested. The fly is attracted to these fields, and finding a more luxuriant vegetation, and a more shady covert here than elsewhere, and meeting with all the accommodations which it desires, it here remains, even though adjoining fields separated only by an open fence, have come forward sufficiently to afford at least a part of the brood, quarters equally as comfortable. To us it appears evident, from these premises, that if one or two acres across the middle of a large field be sowed with wheat about the middle of August, all the flies in the vicinity will be attracted to this point, and there retained ; so that it will be perfectly safe to sow the remainder of the field by the middle of September. If the Hessian fly is common in the neighborhood, the early sowed strip will be badly infested. If so, let it be turned under by the plow, either after two or three severe frosts have rendered it certain that the season for depositing the eggs is fully past, or early in the following spring—resowing it with winter wheat in the former case, or with spring wheat in the latter. By this procedure all the larvæ will be buried and perish. Only in one contingency, as we can perceive, will this plan be inexpedient or liable to fail, namely, when the flies are present in such vast numbers, that the decoy thus prepared is inadequate fully to accommodate them. Upon this point, the amount of damage done at the preceding harvest, will enable the cultivator to judge with a considerable degree of certainty. The advantages which this plan promises, are, that it draws all the insects of the neighborhood together, and destroys their entire progeny ; it enables most of the grain to be sowed as early as is desirable ; and finally, there will no second or spring generation come forth in the field to attack any part of the crop. This measure therefore, should receive a fair trial from some intelligent wheat grower in a district suffering under this pest.

10. *Deeply covering the seed.*—From the letters of a King William County Farmer, and from the specimens furnished by him to Mr. Garnett, which are figured in the *American Farmer*, (vol. ii. p. 174,) the following facts would seem to be conclusively established,

to wit :—That when a kernel of wheat is buried to the depth of about three inches, it sends a single stem upwards, which, within an inch of the surface forms a crown, sending from that point a tuft of fibrous roots downwards, and a tuft of blades upwards ; these become the main roots and stalks, if undisturbed. But if these be destroyed by the fly, a new set of shoots and roots start directly from the deep buried kernel, and these latter shoots are never attacked by the fly. A kernel but slightly covered, on the other hand, sends up its blades at once directly from the seed ; if these be attacked therefore, the whole is destroyed. Such is a brief but plain statement, we believe, of the argument of the King William Farmer. In other words, seed slightly covered can send up but a single set of shoots, and being attacked by the fly, the whole perishes ; but seed deeply buried can send up a double set of shoots ; those first appearing are attacked and destroyed ; those which thereupon start directly from the seed are never infested by the fly. Admitting the facts to be as set forth, it amounts to this, that by deeply covering, the same quantity of seed in reality produces two crops ; one, which is speedily harvested by the fly ; and the other, gathered at a later day by human hands. To this procedure we have two objections. By adopting it, you do nothing whatever towards destroying the insect or frustrating it in the least in its operations. On the contrary, you aim to provide food for it. You cherish it. You, in effect, say to it, “be fruitful, multiply, and replenish the earth.” True, by giving it what it wants, it leaves us as much more. But it is rather humiliating to us “lords of creation” to rear crops “at the halves” and place ourselves in the rank of mere tenants to so ignoble a landlord ! Again, this measure only shields us against the autumnal attack. It does nothing against that of the following spring. Nay, by providing so well for the first generation, it tends to make the second generation more numerous, and the spring attack consequently more severe. Thus much upon the supposition that the facts are precisely as set forth by the King William Farmer. That he sincerely believed them to be correct, and that he was perfectly honest in the selection of the specimens which he forwarded to Mr. Garnett, we do not in the least doubt. Indeed the encomium which Mr. G. has written upon the character of his friend, must forever place him above all suspicions of insincerity or of anything approach-

ing to chicanery. But our own observations impress upon us strongly the conviction that he is in error in one most important point in his argument, namely, that seed slightly covered, dies whenever its blades are destroyed by the fly. It is only in an impoverished soil that it thus dies ; in a rich soil, as has been already stated, its vitality continues, its roots are so well surrounded with nutriment that they readily sustain it, and its first shoots being destroyed, it sends up a second set which grow unharmed. It thus performs the same operation which the King William Farmer contends, it can only do when deeply buried. Our specimen, from which the drawing (fig. A,) was taken, plainly shows this fact. The illustration is an exact copy from nature, of two shoots which were separated from a tuft of similar ones, all growing from one shallow covered seed ; and in every infested field which we have examined, myriads of similar specimens might have been gathered, whilst commonly only on knolls and other barren or dry parts of the fields were the plants found to be wholly destroyed, as they are represented in the figures of the *American Farmer*. A fertile soil therefore insures the same results which are claimed for a deep covering of the seed. In both cases, the shoots which first appear are destroyed ; another set appear afterwards, which are unharmed—not because the seed is buried too deep for the worms to crawl down to it, as the King William Farmer seems to infer, but because there are no flies any longer abroad to deposite their eggs upon the leaves. The exact truth then, with regard to this matter, we are firmly persuaded is as follows. In a meagre soil, the seed will die, whether it be covered slightly or deeply. In a less impoverished soil, *if the weather be dry* in September as it frequently is, seed near the surface will often perish, when that which is deeply buried will survive. In a fertile soil the seed will survive, whether it be covered shallow or deep. That suits of specimens can therefore be easily procured which will appear to demonstrate a state of things in every particular the very reverse of those figured in the *American Farmer*, scarcely admits of a doubt. Our conclusion then is, that the King William Farmer is measurably correct in his position, but by no means correct to the extent contended for. When the Hessian fly is present in any district, deeply covering the seed, especially if it be early sowed, will in most cases be an additional safeguard against

its destruction. The measure is therefore good as a subordinate one, but it must fall far short of ranking as a primary one.

11. *Procuring seed from uninfested districts.*—This measure also, is based upon the erroneous supposition that the eggs are deposited upon the grain. It can consequently be of no utility whatever as a safeguard against the Hessian fly. The measure has been fairly tested in several instances without success.

12. *Sun-drying the seed.*—Mr. W. H. Hill, in the *Nashville Agriculturist* of 1842, states that for fifteen years his wheat crops had not been injured by the Hessian fly, whilst those of his neighbors had suffered more or less. This immunity he attributes to two causes; exposing his seed to the sun for two days previous to sowing it, and sowing none but the largest and fullest grains, the others being separated by a sieve. Doubtless stronger roots and a more vigorous growth is obtained by sowing large, plump seed. We think that effectually drying the seed in the sun can have but one effect, that of retarding its germination a short time—an end that may be equally as well attained, and with less trouble, by deferring the sowing until a somewhat later period.

13. *Drawing elder bushes over the young plants.*—We have here one of the fancies of a former day, it being supposed that elder possessed an odor or some more occult property, which rendered it peculiarly repulsive to insects. A trial of it against the Hessian fly, however, soon demonstrated that it possessed little or no virtue of that kind in reference to this insect. If any benefit ever resulted from it, it was probably only by dislodging and brushing off some of the eggs from the blades of the wheat.

14. *Sprinkling fine salt, ashes, or caustic lime over the young plants.*—The first of these measures was proposed, from its appearing at one time that wheat growing upon points of land exposed to the sea air was less injured than that growing back from the coast. Neither of these remedies, however, have been attended with success, in any case on record, and they probably are of no service whatever, except as they may slightly increase the fertility of some fields. There is no likelihood that the fly, its eggs, or larvæ can be materially discommoded by them.

15. *Burning and plowing up the wheat stubble.*—This measure was originally proposed by Judge Havens, and has been unanimously approved of and strongly urged by several of the most intelligent writers since. Indeed, a slight examination can scarcely fail of impressing upon every one its utility, independent of the sanction of authority. Whoever will at, or soon after harvest, inspect the stubble of a field that has been badly infested by the Hessian fly, will find these insects in their flax seed state lying one, two, three or more, at the joints of perhaps half the straws of the field. What a trifling labor, or rather what a pastime will it now be to set fire to this dry stubble, and hereby inevitably consume countless thousands of these destroyers. This point appears so plainly evident, that no one, we think, will hesitate in pronouncing this remedy decidedly the most important and valuable of all. But a thought breaks in upon us, of such fearful import, that fancying we see the burning brand extended, in an instant more to send a sheet of vivid flame, leaping, hissing, and crackling over the fated field, we involuntarily shout,

“Stop! or thy tread is on an empire’s dust!”

Of a truth, what a short sighted mortal is man, and how often are the words of the poet verified, that “a little knowledge is a dangerous thing.” Seeing his enemy chained to the stake, he exultingly rushes at once to fire the faggots, and lo, a dozen of his friends are immolated upon the same pyre! Is it not a fact, that whilst by this measure we consume the Hessian fly by hundreds, we inevitably destroy its mortal foes by thousands? And that the very means which we thus resort to for averting a future calamity are the surest means that could be devised for bringing that calamity upon us! If nine-tenths of every generation of the Hessian fly are destroyed by three or four other insects, who can calculate the value of the services which these latter are yearly rendering us? And who, then, will be so inconsiderate and ruthless as to destroy *nine* of these useful parasites, in order to exterminate *one* Hessian fly! Yet this must, in most cases, be the result of burning the stubble of the wheat field. We commenced our account of this remedy impressed with a belief that it was the best that had ever been proposed; we close it, persuaded that it is the very worst.

Brief Summary of the preceding History.

The Hessian fly (*Cecidomyia destructor* of Say,) is a European insect, and has been detected in Germany, France, Switzerland and Italy, where it at times commits severe depredations upon the wheat crops. Its ravages are alluded to so far back as the year 1732. It was brought to this country, probably in some straw used in package by the Hessian soldiers, who landed on Staten and the west end of Long Island, August, 1776, but did not become so multiplied as to severely injure the crops in that neighborhood, until 1779. From thence as a central point, it gradually extended over the country in all directions, advancing at the rate of from ten to twenty miles a year. Most of the wheat crops were wholly destroyed by it within a year or two of its first arrival at a given place, and its depredations commonly continued for several years, when they would nearly or quite cease; its parasitic insect enemies probable increasing to such an extent as to almost exterminate it. It is frequently reappearing in excessive numbers in one and another district of our country, and in addition to wheat, injures also barley and rye.

There are two generations of this insect annually. The eggs resemble minute reddish grains, and are laid in the creases of the upper surface of the leaf, when the wheat is but a few inches high, mostly in the month of September. These hatch in about a week, and the worm crawls down the sheath of the leaf to its base, just below the surface of the ground, where it remains, subsisting upon the juices of the plant, without wounding it, but causing it to turn yellow and die. It is a small white maggot, and attains its growth in about six weeks. It then changes to a flax seed like body, within which the worm becomes a pupa the following spring, and from this the fly is evolved in ten or twelve days. The fly closely resembles a musquitoe in its appearance, but is a third smaller, and has no bill for sucking blood; it is black, the joints of its body being slightly marked with reddish. It appears early in May, lays its eggs for another generation and soon perishes. The worms from these eggs nestle at the lower joints of the stalks, weakening them and causing them to bend and fall down from the weight of the head, so that towards harvest, an infested field looks as though cattle had passed through it.

Wheat can scarcely be grown except upon a fertile soil in those districts where this insect is abundant. The sowing should be deferred until about the last of September, the season then being past, when the fly usually deposits its eggs. If at any time in autumn the eggs of the insect are observed to be profusely deposited upon the leaves, the crop should be speedily grazed down by sheep and other stock, or if this cannot be done, a heavy roller should be passed over it, that as many of the eggs as possible may be crushed or dislodged thereby. One or the other of the same measures should also be resorted to in the spring, if the same contingency occurs; or if the worms are at a later date discovered to be numerous at the first and second joints of the young stalks, the experiment may be tried of mowing as close down as possible, the most infested portion of the field. Where the soil is of but medium fertility, a resort to some of the hardier varieties of wheat, which are known to be in a measure fly proof, may be advisable.

Fitch's Point, Salem, N. Y., April, 1847.

Note.—Since our preceding essay, upon the *Cecidomyia tritici*, was published, having had an opportunity of perusing the original articles of Mr. Kirby upon that species, we find that he both figures and describes the joints of its antennæ as “medio constrictio.” It is singular that this most important distinctive mark has been so misstated in the descriptions of that species which have been republished upon this side of the Atlantic, and also in Turton's edition of the *System of Nature*. From the remarks introductory to our “Description,” some might perhaps infer that this error arose with the founder of the species. We hasten, therefore, to obviate any such impression.

DESCRIPTION OF THE PLATE.

- Fig. 1.** *Agrilus ruficollis*, Fab. *a.* Its natural length.
- Fig. 2.** Hessian fly, male. (*Cecidomyia destructor*.) From a young specimen, having the fulvous sutures of the abdomen wide.
- b.* Its natural size.
 - c.* Ventral view of the terminal segments of its abdomen.
 - d.* Joints of its antenna.
- Fig. 3.** Hessian fly, female. (*C. destructor*, ♀.) From an older specimen, having the fulvous sutures narrow and in part obliterated.
- e.* Joints of its antenna.
 - f.* Profile view of the head, palpi, and origin of the antenna.
 - g.* Dorsal view of the worm or active larva.
 - h.* do do "flax seed," or larva case.
 - i.* Ventral view of the same.
 - j.* Lateral view of the same.
 - k.* Dorsal view of the dormant larva, taken from the larva case.
 - l.* Ventral view of the pupa.
 - m.* Wheat stalk; sheath broken away, showing the young worms on their way to the joint.
 - n.* and *o.* Wheat stalks; sheath broken away, showing the "flax seeds" in their ordinary situation.
- A.** Appearance of a healthy (*), and of a diseased (†) shoot of wheat in autumn, the worms lying at §.
- B.** Appearance of a healthy (**), and two diseased stalks of wheat at harvest time. (††) Stalk broken, from being weakened by the worms. §§ Base of sheath swollen from worms having laid under it, and perforated by parasites coming from those worms.

